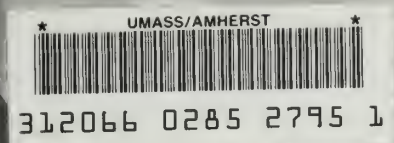


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BOSTON MPO TRANSPORTATION PLAN 2000-2025



BOSTON MPO TRANSPORTATION PLAN, 2000–2025

Prepared by the Central Transportation Planning Staff for the Boston Metropolitan Planning Organization (MPO), which is composed of:

Executive Office of Transportation and Construction

City of Boston

City of Everett

City of Newton

City of Peabody

Federal Highway Administration

Federal Transit Administration

Joint Regional Transportation Committee

Massachusetts Bay Transportation Authority

Massachusetts Bay Transportation Authority Advisory Board

Massachusetts Highway Department

Massachusetts Port Authority

Massachusetts Turnpike Authority

Metropolitan Area Planning Council

Town of Bedford

Town of Framingham

Town of Hopkinton



THE BOSTON METROPOLITAN PLANNING ORGANIZATION REGION

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TABLE OF CONTENTS

1	INTRODUCTION AND POLICIES	1
2	PHYSICAL AND ENVIRONMENTAL CONDITIONS	13
3	DEMOGRAPHICS OF THE REGION	35
4	ROADWAY SYSTEM	43
5	TRANSIT SYSTEM	61
6	BICYCLE AND PEDESTRIAN TRANSPORTATION	77
7	INTERCITY TRAVEL	89
8	FREIGHT TRANSPORTATION	99
9	FORECAST OF 1995 BASE CASE AND 2025 BUILD SCENARIOS	107
10	RECOMMENDED PLAN	121
11	FINANCIAL PLAN	127
12	ENVIRONMENTAL JUSTICE MEASURES	147
13	AIR QUALITY CONFORMITY DETERMINATION	165
14	NEXT STEPS	179
APPENDIX A	PROJECTS INCLUDED IN THE TRANSPORTATION PLAN	183
APPENDIX B	GLOSSARY OF TERMS	197
APPENDIX C	OTHER PLANNING EFFORTS	203
APPENDIX D	SUPPLEMENTAL INFORMATION FOR THE AIR QUALITY CONFORMITY DETERMINATION	213

PLAN 20000

FIGURES, TABLES, AND MAPS

FIGURES

1-1	CHRONOLOGY OF SIGNIFICANT MPO STATUTES, DOCUMENTS AND EVENTS	3
2-1	CHANGE IN LAND USE IN THE BOSTON REGION, 1971–1991	14
3-1	DEMOGRAPHIC SHIFTS IN THE BOSTON REGION	36
3-2	CHANGES IN DEMOGRAPHICS IN THE BOSTON REGION	38
4-1	BREAKDOWN OF ROADWAY OWNERSHIP, CLASSIFICATION AND TYPE	44
4-2	ROADWAY CLASSIFICATION AND VMT	44
4-3	CLASSIFICATION OF BRIDGES	47
6-1	HIGHEST PEDESTRIAN CRASH LOCATIONS (FROM 1995 TO 1997)	83
6-2	LOCATION OF PEDESTRIAN AT TIME OF ACCIDENT (MASSACHUSETTS)	84
6-3	HIGHEST BICYCLE CRASH LOCATIONS (FROM 1995 TO 1997)	84
6-4	CHANCE OF PEDESTRIAN FATALITY	86
7-1	DOMESTIC INTERCITY PASSENGER MILES BY MODE	89
7-2	1999 PASSENGER ACTIVITY AT NEW ENGLAND REGIONAL AIRPORTS AND LOGAN AIRPORT	90
7-3	1991–1998 AIRCRAFT OPERATIONS AT LOGAN	92
7-4	INTERCITY TRAVEL BETWEEN BOSTON AND NEW YORK BY MODE	98
8-1	RAIL CAR CLEARANCES	101

TABLES

2-1	LARGEST CHANGES IN POPULATION AND EMPLOYMENT FOR TRENDS EXTENDED SCENARIO	27
2-2	WATER AND SEWER CONSTRAINTS SCENARIO CHANGES VERSUS SCENARIO A	28
2-3	COMMUNITIES WITH LARGEST ADDITIONAL POPULATION INCREASES SCENARIO C VERSUS SCENARIO B	28
4-1	OWNERSHIP OF THE REGIONAL HIGHWAY SYSTEM (LANE MILES)	43
4-2	CLASSIFICATION OF BRIDGES BY OWNER	45
4-3	CRASH LOCATIONS	59
5-1	MBTA VEHICLE FLEET BY YEAR BUILT	63
5-2	CHARACTERISTICS OF THE RAPID TRANSIT SYSTEM	64
5-3	CONSTRUCTION COSTS FOR MBTA COMMUTER PARKING SPACES	73
8-1	CARGO VOLUMES (IN TONS) AT LOGAN AIRPORT, 1991–1998	105
9-1	TRAVEL MODEL RESULTS	113
9-2	TRAVEL MODEL RESULTS	114
9-3	TRAVEL MODEL RESULTS	115
9-3	TRAVEL MODEL RESULTS	116
9-4	MODE SPLIT MODEL RESULTS: 1995, 2003B, 2025NB AND 2025B	117
9-5	TRAVEL MODEL RESULTS	118
9-6	COMMUTER RAIL AND RAPID TRANSIT BOARDINGS: 1995, 2003B, 2025NB AND 2025B	119
10-1	REGIONALLY SIGNIFICANT AND OTHER LARGE PROJECTS	125
11-1	FEDERAL-AID HIGHWAY FUNDS AVAILABLE FOR THE CENTRAL ARTERY PROJECT	128
11-2	SOURCE OF REMAINING STATE OBLIGATIONS FOR THE CENTRAL ARTERY PROJECT	129

11-3	REVENUE TO FUND THE REMAINING CENTRAL ARTERY PROJECT OBLIGATIONS	130
11-4	HIGHWAY SPENDING BY TYPE	131
11-5	PROJECTED OPERATIONS AND MAINTENANCE COSTS OF THE CURRENT MBTA SYSTEM	133
11-6	PROJECTED HIGHWAY REVENUES COMPARED TO IDENTIFIED NEEDS	132
11-7	PROJECTED OPERATIONS AND MAINTENANCE COSTS OF THE CURRENT MBTA SYSTEM	135
11-8	PROJECTED OPERATING REVENUE OF THE CURRENT MBTA SYSTEM	136
11-9	THE MBTA CAPITAL PROGRAM BY SOURCE	137
11-10	FUNDING THE NON-FEDERAL SHARE OF THE MBTA CAPITAL PROGRAM	137
11-11	THE TRANSIT CAPITAL PROGRAM	138
12-1	ENVIRONMENTAL JUSTICE MEETINGS ON THE RTP	149
12-2	SCHEDULED HEADWAYS FOR MBTA BUS ROUTES	158
12-3	LOAD FACTORS ON THE MBTA SYSTEM	159
12-4	CROWD FACTORS ON THE MBTA SYSTEM	159
12-5	AVERAGE AGE AND COMFORT OF MBTA VEHICLES	160
13-1	2000 TRANSPORTATION PLAN: FUTURE NEEDS ANALYSIS ACTION SCENARIOS	173
13-2	VOC EMISSIONS ESTIMATES FOR THE EASTERN MASSACHUSETTS OZONE NONATTAINMENT AREA	176
13-3	NOX EMISSIONS ESTIMATES FOR THE EASTERN MASSACHUSETTS OZONE NONATTAINMENT AREA	176
13-4	WINTER CARBON MONOXIDE EMISSIONS FROM THE CO MAINTENANCE AREA FOR THE NINE CITIES IN THE BOSTON AREA	176
13-5	WINTER CARBON MONOXIDE EMISSIONS FROM THE CO NONATTAINMENT AREA ONLY FOR THE CITY OF WALTHAM	177
D-1	MOBILE 5 A-H INPUTS – YEAR 1995 CONDITIONS	214
D-1	MOBILE 5 A-H INPUTS (CONT.) – YEARS 2003 THROUGH 2020	215
D-1	MOBILE 5 A-H INPUTS (CONT.) – YEARS 2003 THROUGH CONDITIONS	216
D-2	VOC EMISSION FACTORS – MOBILE 5A-H	217
D-2	NOX EMISSION FACTORS – MOBILE 5A-H	218
D-2	WINTER CO EMISSION FACTORS – MOBILE 5A-H	219
D-3	STATUS REPORT OF THE 1979, 1982 AND CENTRAL ARTERY STATE IMPLEMENTATION PLAN TCMS	220
D-3	STATUS REPORT OF THE 1979, 1982 AND CENTRAL ARTERY STATE IMPLEMENTATION PLAN TCMS	221
D-3	STATUS REPORT OF THE 1979, 1982 AND CENTRAL ARTERY STATE IMPLEMENTATION PLAN TCMS	222
D-4	CATEGORICALLY EXEMPT PROJECTS	223
D-4	CATEGORICALLY EXEMPT PROJECTS	224
D-5	SUMMARY OF OFF-MODEL EMISSIONS FOR MBTA BUSES, COMMUTER RAIL, COMMUTER BOAT WITHIN AND SURROUNDING THE BOSTON MPO AREA	225

MAPS		
2-1	CONCENTRATED DEVELOPMENT CENTERS	16
2-2	AREAS OF CRITICAL ENVIRONMENTAL CONCERN	18
2-3	SCENARIO A: TRENDS EXTENDED; TRANSPORTATION ANALYSIS ZONES (TAZs)	21
2-4	SCENARIO B: WATER AND SEWER CONSTRAINTS	22
2-5	SCENARIO B: WATER AND SEWER CONSTRAINTS; TRANSPORTATION ANALYSIS ZONES (TAZs) DENSITY RANGES FOR COMBINED POPULATION AND EMPLOYMENT DENSITIES	23
	DENSITY RANGES FOR COMBINED POPULATION AND EMPLOYMENT DENSITIES	24
2-6	WATER SUPPLY CONSTRAINTS SCENARIO	25
2-7	TARGETED GROWTH SCENARIO DIFFERENCE IN POPULATION AND EMPLOYMENT DENSITY	26
4-1	ROADWAY MOBILITY PROBLEMS BY SOURCE OF IDENTIFICATION	46
4-2	HIGHEST CRASH LOCATIONS	58
4-3	CENTRAL ARTERY PROJECT STATUS	51
4-4	THE METROPOLITAN HIGHWAY SYSTEM	52
5-1	MBTA SYSTEM	62
5-2	COMMUTER RAIL SYSTEM	66
5-3	PARK-AND-RIDE LOTS	74
6-1	DR. PAUL DUDLEY WHITE BIKE PATH	78
6-2	MINUTEMAN COMMUTER BIKEWAY	79
6-3	EXISTING AND PROPOSED BICYCLE FACILITIES	85
7-1	INTERCITY TRAVEL	91
9-1	REGIONAL MODEL AREAS	108
MAP	MBTA BUS AND TRANSIT SERVICE: CENSUS WITH MINORITY POPULATION	151
MAP	MBTA BUS AND TRANSIT SERVICE: LOW INCOME CENSUS	153
MAP	MBTA RAPID TRANSIT SERVICE: CENSUS WITH MINORITY POPULATION	155
MAP	BRIDGE CONDITIONS	161
A-1	1995 BASE CASE AND PROJECTS FOR 2025 BUILD HIGHWAY	194
A-2	1995 BASE CASE AND PROJECTS FOR 2025 BUILD TRANSIT	195



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CHAPTER 1

INTRODUCTION AND POLICIES

THE TRANSPORTATION PLAN: PROCESS AND POLICIES

The Transportation Plan for the Boston region comprises the policies, strategies, and priorities for the region's transportation system for the next 25 years. The underlying philosophy of the Plan is to strive to deliver a high level of transportation service to all stakeholders, within the constraints of total available resources. This Plan is the first stride towards creating a framework for making intelligent decisions about transportation investments. It is important to note that much work remains to be done during the winter and spring of 2001.

Due to federal regulations and deadlines, the Boston MPO is preparing the Transportation Plan in two stages. The U.S. Department of Transportation and the Environmental Protection Agency (EPA) require the region to have an updated plan in place by January 16th, 2001. This updated plan must satisfy (or conform) EPA air quality regulations. In order to do this, the Boston MPO adopted this plan on January 11, 2001. The plan contains initial policies, analyses, and recommendations sufficient for the federal review.

However, the Boston MPO wishes to emphasize that substantial additional work will be done after this first stage. For example, there must be additional analyses of the transportation effects of alternative land-use scenarios and transportation networks, the plan's initial policies and environmental justice measures will need to be refined, and the public must be provided with additional opportunities to review, comment on, and contribute to the plan. Accordingly, the second stage of the planning effort will begin in January 2001. The Boston MPO will continue to work on the plan through the winter and spring, with the objective of adopting a refined plan before the summer of 2001.

The planning process must consider the need to fairly allocate the costs and benefits of transportation investments. In the development of the Transportation Plan, the MPO used a public involvement pro-

gram that went beyond traditional measures in order to better assess the effect of proposed transportation policies on traditionally under-served populations, including minority and low-income households. The MPO intends to continue and expand its efforts to incorporate environmental justice considerations into planning and programming decisions.

The core metropolitan transportation planning requirements of the federal Transportation Equity Act for the 21st Century (TEA-21) emphasize the role of state and local officials, in cooperation with transit operators, in tailoring the planning process to meet metropolitan transportation needs. It is the intent of the Boston MPO to take a unified and inclusive approach to problem solving. This approach must fairly consider the needs and priorities of the urbanized core communities, mature suburbs, and rapidly growing exurban towns. Therefore, the planning process must include the participation of the full spectrum of communities as well as the transportation agencies that operate and maintain the transportation system. While not always easy to achieve, the MPO will continue to strive for cooperation, consensus, and balance as it moves into the 21st century.

economy not only of Massachusetts, but also to all of New England.

The Boston MPO is a cooperative board of 14 state, regional, and local entities. Its primary purpose is to carry out the continuing, cooperative, and comprehensive transportation planning process first established by the Federal-Aid Highway Act of 1962. Often referred to as the "3C" process, it is intended to serve as a framework for making transportation investment decisions in metropolitan areas.

Metropolitan transportation planning in the Boston region was formalized in January 1973 through a Memorandum of Understanding signed by representatives from the Executive Office of Transportation and Construction, the Massachusetts Highway Department, the Massachusetts Bay Transportation Authority, and the Metropolitan Area Planning Council. These four agencies agreed that they would:

- Work together on the federally required transportation planning process
- Establish a Joint Regional Transportation Committee (JRTC) to ensure citizen participation in regional transportation planning
- Work together to ensure compliance with federally mandated planning documents
- Establish a joint staff to support decision making (the Central Transportation Planning Staff, CTPS, began operations in 1974)

WHAT IS THE BOSTON MPO?

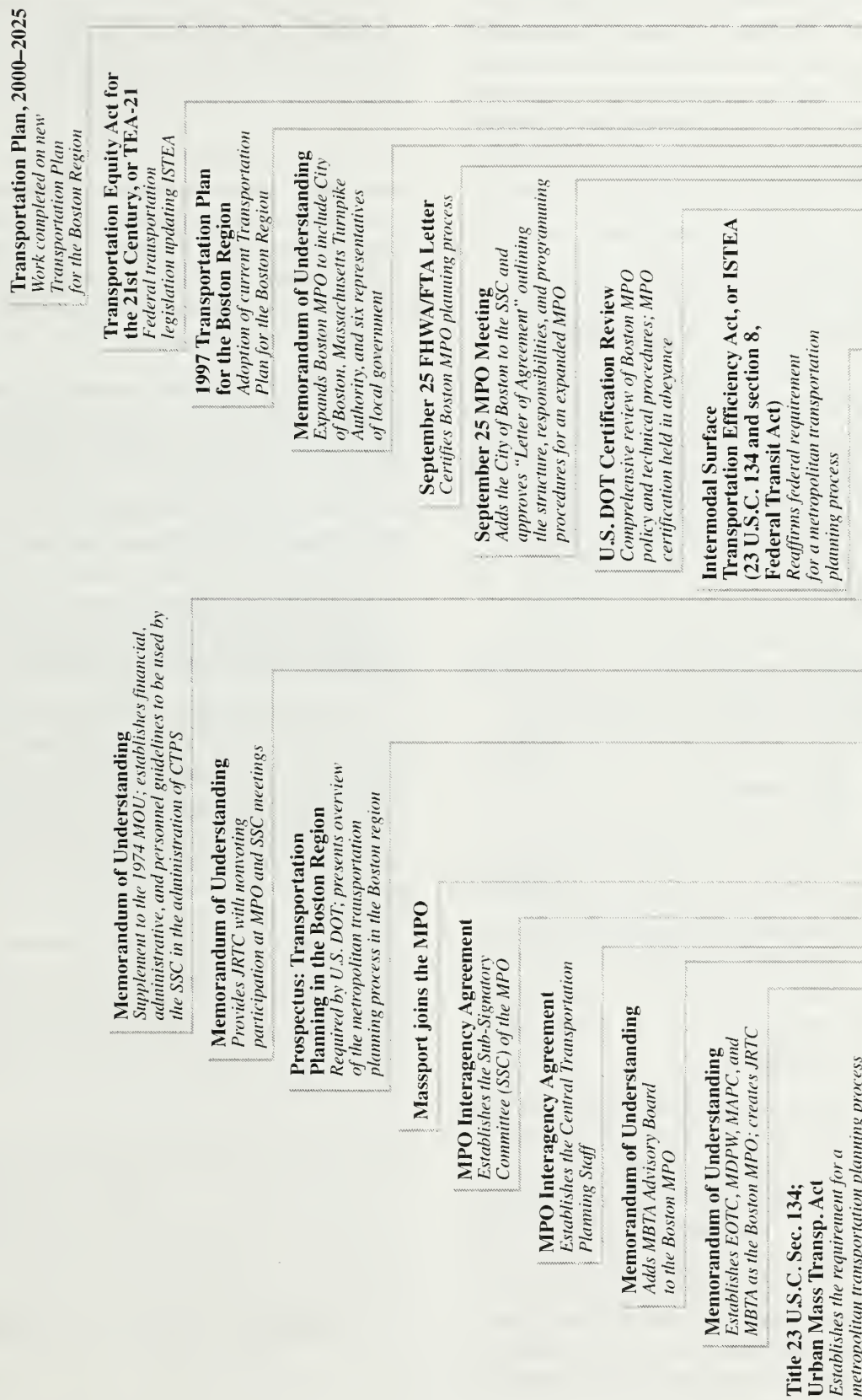
The Boston Metropolitan Planning Organization region covers approximately 1,405 square miles and encompasses 101 cities and towns. It is the commonwealth's largest MPO and, with nearly three million people, it comprises nearly half of the state's population. With close to two million jobs, the Boston MPO region is important to the

The MPO expanded in 1974 by adding the MBTA Advisory Board; this was followed by a further expansion in 1976 with the addition of the Massachusetts Port Authority.

The next change in the composition of the MPO occurred on January 7, 1997, when the MPO expanded to include the city of Boston and the Massachusetts Turnpike Authority as permanent

FIGURE 1-1

Chronology of Significant MPO Statutes, Documents and Events



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members. At the same time, six municipal representatives (three to be elected every two years) were added. Currently, the cities of Everett, Newton and Peabody and the towns of Bedford, Framingham and Hopkinton are members of the MPO. Also in 1997, the MPO added the JRTC, the Federal Highway Administration, and the Federal Transit Administration as nonvoting members.

Figure 1-1 is a chronology of significant MPO statutes, documents, and events.

PURPOSE OF THE TRANSPORTATION PLAN

Preparation of a long-range transportation plan is a federal requirement for all metropolitan areas. Its primary use is to set regional priorities for federally funded projects. The Plan also serves as a comprehensive, coordinated transportation plan for all the implementing agencies within the metropolitan area.

The new Plan is being prepared in accordance with the requirements of TEA-21, the current federal surface transportation act. TEA-21, was authorized by Congress in 1998 and identifies seven key policy areas which must be supported by the planning process.

The MPO used the TEA-21 emphasis areas to structure the development of the guiding policies for this plan. The Boston MPO Transportation Plan policies and implementation strategies are presented on the following pages.

GUIDING PRINCIPLES AND STRATEGIES FOR PLAN 2000

The 2000 Regional Transportation Plan (the Plan) recognizes the diversity of transportation needs and issues throughout the Boston region and attempts to respond to these needs and issues in a balanced manner. This Plan sets the policies, supports the projects, and identifies the actions necessary to serve all modes of transportation for persons and freight in this metropolitan region and by so doing, addresses the issues of congestion and sprawl while supporting economic vitality and environmental justice.

While advocating a transportation system that adequately serves all modes of travel, the plan recognizes that many people of the region are reliant on the automobile and will continue to be over the life of the Plan. We expect both roadway congestion and the demand for transit to increase in the future. The Plan also recognizes that many possibilities exist to reduce our need to drive, by changing our transportation pricing policies or land use practices, for example. The Plan therefore, also stresses the need to develop a transportation system that expands our choices for travel within the region.

Sprawling development is wasteful of limited infrastructure dollars and detrimental to the quality of life which is an essential component of our economic competitiveness. Consequently, this Plan attempts to be generally consistent with MetroPlan, the adopted land use plan for the Boston region. Regional decisions to prioritize transportation investments, pricing policies, and system maintenance will help shape the future of the Boston region and its sustainability.

The Plan also seeks to provide access to transportation services on an equitable basis across the region. This includes insuring that low-income and minority communities have transportation options to travel to jobs, and that transit-dependent residents can reach needed services across the region.

Finally, the Plan recognizes that the transportation system plays a critical role in the continued economic health of the region. Many sectors of the regional economy heavily depend on the safe and efficient movement of goods and services by truck, rail, air, and water.

The following Boston MPO policies and strategies are applicable to all MPO activities, with particular emphasis on the Regional Transportation Plan, the Transportation Improvement Program, and the Unified Planning Work Program.

Policy 1

Support the economic vitality of the Boston Region through timely transportation investments, thereby enabling competitiveness, productivity, and efficiency.

The transportation system is fundamental to and intertwined with economic activity. Development should be guided to appropriate locations where infrastructure is in place, where the environmental conditions can sustain further growth and where energy efficient and environmentally sound transportation services are available.

To accomplish this policy, the Boston MPO will:

- A. Encourage economic growth where adequate transportation and other infrastructure exists.
- B. Prioritize transportation projects that improve services in and to centers of economic activity.
- C. Identify appropriate strategies that fairly share the burdens of truck impacts regionally while minimizing the impacts on residential neighborhoods and the environment.
- D. Identify and prioritize bridges on routes identified as preferred regional truck routes in order to maintain the structural integrity necessary to accommodate truck traffic.
- E. Identify and prioritize bridges needing major structural repairs on designated double-stack freight routes.
- F. Support projects that improve access to intermodal facilities such as airports, ports, rail facilities, and ferry terminals.
- G. Encourage efforts to ensure that freight moves through the region efficiently, and that goods can be delivered quickly with minimal impact on residents.

Policy 2

Ensure and increase the safety and security of transportation system users, regardless of mode.

Before using the transportation system, travelers must be confident of a safe and secure trip, regardless of mode. Physical safety can be enhanced through careful attention to design, redesign, and upgrading of facilities. Operational safety can be ensured through adherence to proper operating procedures and effective maintenance.

To accomplish this policy, the Boston MPO will:

- A. Support designs, projects, and programs that encourage bicyclists, motorists, transit riders and pedestrians to share the transportation network safely, and consider and support the use of traffic calming when appropriate.
- B. Work with state agencies and communities to support design concepts for regional and local roads that balance safety and the function and character of surrounding land uses.
- C. Support the inclusion of appropriate pedestrian improvements in highway and transit projects.
- D. Support the inclusion of appropriate bicycle improvements in highway and transit projects.
- E. Support projects and activities that enhance transit safety and security.

Policy 3

Improve mobility for people and freight by providing transportation options, improved service, and efficient system management and operations.

Improved mobility requires access to the transportation system, and the availability of travel choices to allow users access to the services that best fits their needs. One way to increase these choices and improve efficiency is to apply appropriate new technology.

To accomplish this policy, the Boston MPO will:

- A. Support projects and programs to improve transit service by making it faster, more reliable, and more convenient.

- B. Plan and prioritize improved facilities for bicyclists and pedestrians to encourage non-motorized transportation to reduce reliance on single-occupant vehicles
- C. Plan and support programs to reduce demand for transportation services and facilities, including rideshare services and employer-based congestion reduction programs.
- D. Plan and support transportation system management projects and programs that improve the operation of existing services, such as improved signal systems, bus rapid transit, bus lanes and traffic signal preemption, and incident management programs.
- E. Encourage the use of new technology and programs, including highway and transit Intelligent Transportation System programs and bus rapid transit, to improve the operation of the transportation system, improve safety, and reduce congestion.
- F. Support projects that expand transportation system capacity and are identified as problems in the Boston Region Congestion Management System and as dictated by sound fiscal management. Transit capacity can be expanded by increasing service frequency, expanding vehicle capacity, or expanding the system. Highway capacity can be increased by improving interchanges or adding HOV lanes. Adding capacity by building general purpose lanes should be considered only when no demonstrably better solution can be found.

Policy 4

Reduce air pollution and minimize water, soil, and noise pollution, and use transportation enhancement activities to preserve and improve the natural and built environments, making communities and the region more healthy and attractive.

The Clean Air Act Amendments of 1990 (CAAA) provided new requirements to achieve reductions in air pollutants. This plan recognizes that long-term air quality, energy consumption, natural

resource protection, and quality of life may require reduced reliance on single-occupant vehicles and sprawl which reinforces single-occupant vehicle use.

To accomplish this policy, the Boston MPO will:

- A. Place a priority on identifying and evaluating all environmental impacts in all aspects of the transportation planning process.
- B. Encourage, through funding programs, the use of travel modes that contribute to clean air.
- C. Work to develop improved regional strategies that utilize CMAQ funds, to comply with federal Clear Air Act Amendment requirements and provide for future needs.
- D. Encourage projects and programs that increase the use of low-polluting fuels and engine technology in vehicle fleets and transit vehicles.
- E. Encourage the design and construction of facilities that assure that materials used in operations and maintenance will not have detrimental impacts on soil and water.
- F. Support projects and programs that avoid, mitigate and reduce adverse impacts of transportation facilities.
- G. Encourage transportation enhancement projects to preserve and improve the natural and built environment.

Policy 5

Effectively and efficiently integrate and connect the various components of the transportation system, across and between modes, for both people and freight.

The Transportation Plan promotes a multimodal and comprehensive approach to planning, building and operating transportation systems. This integration results in greater mobility and accessibility because the various modes complement each other; the whole may become greater than the sum of its parts. Investment choices should be based in part on the way in which an improve-

ment to a single transportation mode can make the entire system work better.

To accomplish this policy, the Boston MPO will:

- A. Work to improve coordination among the local, regional and state jurisdictions that own and operate the region's transportation system to better provide for local and regional transportation needs.
- B. Insure that the transportation system is appropriately balanced among modes.
- C. Support projects that provide additional capacity at intermodal facilities, such as vehicle and bicycle parking. Support public-private partnerships to promote commuter parking at existing commercial or residential lots.
- D. Support projects that improve the ease of transfer between modes, such as improved facilities and fare collection systems.
- E. Seek strategies that improve regional circumferential mobility and connectivity.
- F. Plan projects that provide street, bicycle and pedestrian connections to transit routes within and between activity centers.
- G. Encourage a regional network of safe and convenient bikeways connected to other transportation modes and local bikeway systems, consistent with regional street design guidelines.
- H. Provide pedestrian and bicycle access, appropriate to existing and planned land uses, street design classification and public transportation, as a part of transportation projects through priority funding for pedestrian and bicycle projects.

Policy 6

Provide a transportation system that is accessible to all people regardless of physical limitations, economic status, or ethnicity, and ensure that transportation system benefits and burdens are shared equitably.

The Americans with Disability Act (ADA) provides comprehensive civil rights protections to individuals with disabilities in the areas of employment, public accommodations, state and local government services, and telecommunications. Something as simple as a poorly maintained sidewalk or a badly designed building entrance can deny access to many citizens. Federal Environmental Justice rules require that the allocation of benefits and burdens ensure that minority and low-income communities are treated equitably in the provision of transportation services and projects.

To accomplish this policy, the Boston MPO will:

- A. Adopt measures of Environmental Justice for the region. Environmental justice considerations will be emphasized in the preparation of the proposed TIP.
- B. Seek to provide access to more and better transportation choices for travel throughout the region and to serve special access needs for all people, including youth, elderly and disabled users.
- C. Work with local, regional and state jurisdictions to identify and assess structural and operational barriers to mobility for transportation disadvantaged populations in current and planned regional transportation systems and seek to address them through a comprehensive program.
- D. Support investments to provide flexibly organized transit to provide access to jobs and reverse commute throughout the region.

Policy 7

Emphasize the preservation and modernization of the existing transportation system. Secure, and apply efficiently, financial resources for the maintenance and modernization of existing facilities and for appropriate system expansion.

Past investment in transportation facilities in the Boston region totals many billions of dollars. This investment has resulted in a system that people and businesses rely on every day. Protecting that investment by preserving and upgrading facilities and services that meet a demonstrated need is a top priority.

To accomplish this policy, the Boston MPO will:

- A. Prioritize projects maintain and improve existing infrastructure rather than projects that build new infrastructure.
- B. Support transportation investments that support a land use pattern that does not require major expansion of the roadways and other system elements.
- C. Seek to identify transportation funds to maintain all transportation services in a sufficient state of repair.

Policy 8

Promote public involvement in all phases of transportation planning and development. This includes developing and using procedures that allow for continual, timely, and meaningful public participation.

All users of the transportation system should have a voice in the transportation decision-making process. The MPO's priority is to take action to ensure that these users are heard.

To accomplish this policy, the Boston MPO will:

- A. Adopt a new MPO Public Participation Plan that provides all users of the transportation system with the opportunity to participate in the transportation-decision making process by holding well-publicized public meetings in various locations around the region; providing information in a simple, jargon-free format; and distributing information in appropriate non-english formats.
- B. Work to simplify information on the project review process, establish timelines, and work with implementing agencies to insure that all communities understand the process.

- C. Implement continued coordination between the Metropolitan Planning Organization (MPO) and the Joint Regional Transportation Committee (JRTC) in the development of the regional Transportation Plan and the Transportation Improvement Program.
- D. Reach out to under-represented persons and groups to ensure that decisions are made through an open and participatory process that includes broad representation.
- E. Continue to understand and analyze transportation needs on a corridor, suburb-to-suburb, and/or sub-area basis, using a multi-modal approach.

Policy 9

Promote the integration of transportation and land use policies that result in more efficient use of the regional transportation system.

Transportation facilities should support land use patterns that help bring jobs, housing, shopping and services closer together. This can be accomplished, in part, through targeting transportation investments to areas identified in local and regional plans as being suitable for concentrated development.

To accomplish this policy, the Boston MPO will:

- A. Identify and preserve corridors for future transportation activities.
- B. Increase walking mode share for short trips and improve access to the region's transportation system through pedestrian improvements and by encouraging changes in land use patterns, design and densities.
- C. Encourage, through infrastructure funding, development patterns that support increased mobility and accessibility, particularly by transit, walking and bicycling.
- D. Work to identify new revenue sources, perhaps including revenue sharing among communities and peak period pricing, to allow communities to share the benefits and burdens of new development.

- E. Work with state agencies and communities to foster transit-oriented design practices.
- F. Consider land use when conducting MPO activities such as planning studies and project programming.

SUMMARY OF NINE PROPOSED POLICIES

Policy 1. Support the economic vitality of the Boston Region through timely transportation investments, thereby enabling competitiveness, productivity, and efficiency.

Policy 2. Ensure and increase the safety and security of transportation system users.

Policy 3. Improve mobility for people and freight by providing transportation options, improved service, and efficient system management and operations.

Policy 4. Reduce air pollution and minimize water, soil, and noise pollution, and use transportation enhancement activities to preserve and improve the natural and built environments, making communities and the region more healthy and attractive.

Policy 5. Effectively and efficiently integrate and connect the various components of the transportation system, across and between modes, for both people and freight.

Policy 6. Provide a transportation system that is accessible to all people regardless of physical limitations, economic status, or ethnicity, and ensure that transportation system benefits and burdens are shared equitably.

Policy 7. Emphasize the preservation and modernization of the existing transportation system. Secure, and apply efficiently, financial resources for the maintenance and modernization of existing facilities and for appropriate system expansion.

Policy 8. Promote public involvement in all phases of transportation planning and development. This includes developing and using proce-

dures that allow for continual, timely, and meaningful public participation.

Policy 9. Promote the integration of transportation and land use policies that result in more efficient use of the regional transportation system.

PUBLIC INVOLVEMENT

In developing the new Transportation Plan, the MPO broadened opportunities for individuals, businesses and communities to provide input. The MPO believes that collecting more ideas and concerns from diverse sources will produce a more equitable Plan that will address the needs of residents throughout the 101 communities within the MPO region.

The heart of the public participation process was a series of meetings taking place at several separate access points. The first occurred after the release of the Existing Conditions document in March 2000. The second access point occurred after the release of the draft final plan in November 2000. The final access point will be in the spring of 2001, after the MPO has had an opportunity to analyze several land use and transportation network scenarios.

BROADENING THE BASE OF INPUT INTO THE TRANSPORTATION PLAN

The continuing public involvement process, in the spirit of TEA-21, will ensure that the issues and policies in the Transportation Plan represent a broad cross section of local communities and interests. It is the intent to obtain more comments from residents and employees in the region as well as to engage a wider variety of respondents in terms of geography, income, and ethnicity.

The Boston region is a thriving, dynamic region. Despite differences between communities, the MPO must strive to balance the regional needs for economic growth and environmental sustainability with the needs of individual communities as defined by those communities. One of the ways that the MPO public outreach process addresses this issue is by helping participants find

common ground on projects involving multiple agencies.

In order to work towards consensus, the MPO designed meetings on the Transportation Plan to provide opportunities for representatives from various parts of the region to interact. A key meeting in this respect was the mayors' meeting in Peabody in February, where nearly 20 of the region's mayors had the opportunity to discuss a vision for the region's transportation system. Another venue for broad interaction was provided by the Joint Regional Transportation Committee (JRTC). This committee, which provides policy advice to the MPO, is composed of representatives from communities, interest groups, and state agencies. A third opportunity of interaction relates to MAPC Subregional meetings. Subregional representatives will have opportunities to discuss the various interests of the eight different subregions.

Given that the Transportation Plan must be a financially constrained document, not all of the comments, suggestions, and projects put forward by the public can be implemented. Formal proposals backed by cities and towns face the same judgment. However, the intent is to provide a source of input into the Plan that reflects the interests and opinions of various communities better than in the past. This clearinghouse of ideas will make for a more equitable and viable plan.

ENVIRONMENTAL JUSTICE

As a matter of policy and equity, the MPO will ensure that environmental justice is served by the Transportation Plan development process. Federal, state, and local agencies as well as special-interest groups have demanded that the MPO take into account the voice of traditionally underserved communities. These communities have tended to include communities of color, lower-income communities, and the transit dependent.

Environmental justice may be defined as equal justice and equal protection under the law with regard to all environmental statutes and regulations, without discrimination based on race, ethnicity, or socioeconomic status. This ideal

assumes that it is a given right for all persons to have a safe, healthy, productive, and sustainable environment. Certain cases have shown that certain disadvantaged communities have disproportionately suffered deleterious effects from the siting of facilities such as power substations or exposure to unhealthy substances in the environment from vehicular emissions while others may not have been provided an adequate allocation of transportation resources.

Environmental justice has become one of the more pressing issues identified for consideration in the Transportation Plan's public outreach. Various members of the SSC recommended a unique forum to discuss environmental justice apart from the community meetings approved by the SSC in the workscope. To avoid the perception that the environmental justice forum is a "separate but equal" meeting and not part of the official public outreach, the MPO will incorporate features in all the community meetings that will promote discussion of environmental justice as it relates to transportation planning.

In addition, as time and staffing permits, MPO staff will meet with groups particularly interested in environmental justice prior to the community meetings to help lay a foundation for fruitful discussion of the subject.

PUBLIC OUTREACH

A successful public outreach program for the Plan demanded an effective campaign to attract targeted groups to speak about transportation issues for the Boston region. The advertising for public meetings used a number of media appropriate for reaching a wide variety of groups. The effort included:

- Direct mailings, including use of the MPO newsletter
- Informational materials sent to community organization newsletters
- Display advertisements in community newspapers
- Car card advertisements in transit vehicles

-
- A Transportation Plan telephone hotline
 - A portion of the MPO web site reserved for the Transportation Plan

The MPO pursued two methods of distributing information about progress on the Transportation Plan directly by mail to various organizations around the Boston region. It mailed brochures and one-page information sheets, and used its newsletter, *Transreport*, to provide updates about the Plan. For instance, the March 2000 issue included a supplemental brochure about the Plan. CTPS distributes *Transreport* to roughly 2,500 persons and organizations.

Newspaper advertising appeared primarily in community newspapers oriented toward specific communities throughout the Boston region. Meeting information now also appears in community calendars in various newspapers. Press releases about the planning process, public meetings, and the results of those meetings were also produced. Advertising inside transit vehicles helped attract more callers to the hotline and visitors to the Web site.

The Transportation Plan telephone hotline allowed interested parties both to find out information about the Plan and leave comments. The MPO is sensitive to the issue of a "digital divide." Persons with Internet access can receive more information in a more timely fashion than those who lack Internet access. Combining the telephone hotline with promptly sent printed material is intended to close this gap. The MPO will use the capabilities of the Internet to provide up-to-date textual and graphic information related to the Transportation Plan. The Internet campaign is taking a two-tier approach. First, MPO staff constructed a Web site specific to the Plan. Second, MPO staff is pursuing methods to attract more visits to the Web site, including links to other sites.

But the MPO realizes that it must do more in terms of public outreach. The MPO will continue to work to expand its base of interested citizens and is willing to listen to suggestions and measures that would help expand this outreach.

CONCLUSION AND NEXT STEPS

The Boston MPO wishes to emphasize that adoption of this document is just the first step in creating a long-range transportation plan for the year 2025. Substantial additional analytic and policy analysis will need to be done subsequent to the January 11 adoption. Chapter 14, Next Steps, details that work.

For example, there must be additional analyses of the transportation effects of alternative land-use scenarios and transportation networks. This plan uses the MAPC Extended Trends Land Use scenario as the basis for its modeling work. Future work will examine alternatives to this scenario. Environmental justice measures will need to be refined, and the public must be provided with additional opportunities to review, comment on, and contribute to the plan. In an effort to provide the public with a preview of the topics that will be discussed this year, Chapter 2 of this plan describes the land-use scenarios that will undergo analysis. Moreover, Chapter 12 contains information, discussion, graphics and analysis related to environmental justice. This topic, also, will receive additional attention this year.

The second stage of the MPO's planning effort will begin in January 2001. The Boston MPO will continue to work on the plan through the winter and spring, with the objective of adopting a refined plan by Summer 2001.

Date		Time		Location		Remarks	



CHAPTER 2

PHYSICAL AND ENVIRONMENTAL CONDITIONS

The Boston region consists of 101 cities and towns in Eastern Massachusetts encompassing approximately 1,405 square miles. The region roughly corresponds to a 20-mile radius around the City of Boston, with the communities traversed by I-495 as its western boundary. The region's expanding transportation system has opened up large tracts of land for residential, commercial, and industrial development. However, there are still many natural resources within the Boston region. Forests make up 39% of the area, with water, wetlands, and open space contributing another 11%. The region is bordered on the east by approximately 550 miles of coastal waterfront and the Boston Harbor Islands National Park. The Greater Boston area provides an urban setting rich in history and waterfront vistas. Inland, the region offers over 25 state forests and parks, as well as numerous freshwater rivers, lakes, and ponds.

LAND USE

The City of Boston, commonly referred to as the "Hub of New England," has been the focus of the economy of the New England area during the last three centuries. Following World War II, changes in land use and development occurred throughout the Boston region. New zoning codes and the construction of new highways opened up large tracts of land for housing development. Thousands of families left the cities and moved to the suburbs. Later, jobs followed the people to the suburbs, and commercially zoned land was developed into commercial and industrial properties. Areas of commercial and industrial development are well established along the Route 128 corridor and are increasing along the I-495 corridor.

Since the 1970s, the region has seen an increase in square miles of residential development with a smaller increase in square miles of land being developed as commercial and industrial properties. As can be expected, this development is occurring on what was once agricultural and forested lands. Figure 2-1 shows the change in the number of square miles of the different land uses from 1971 to 1991 in the

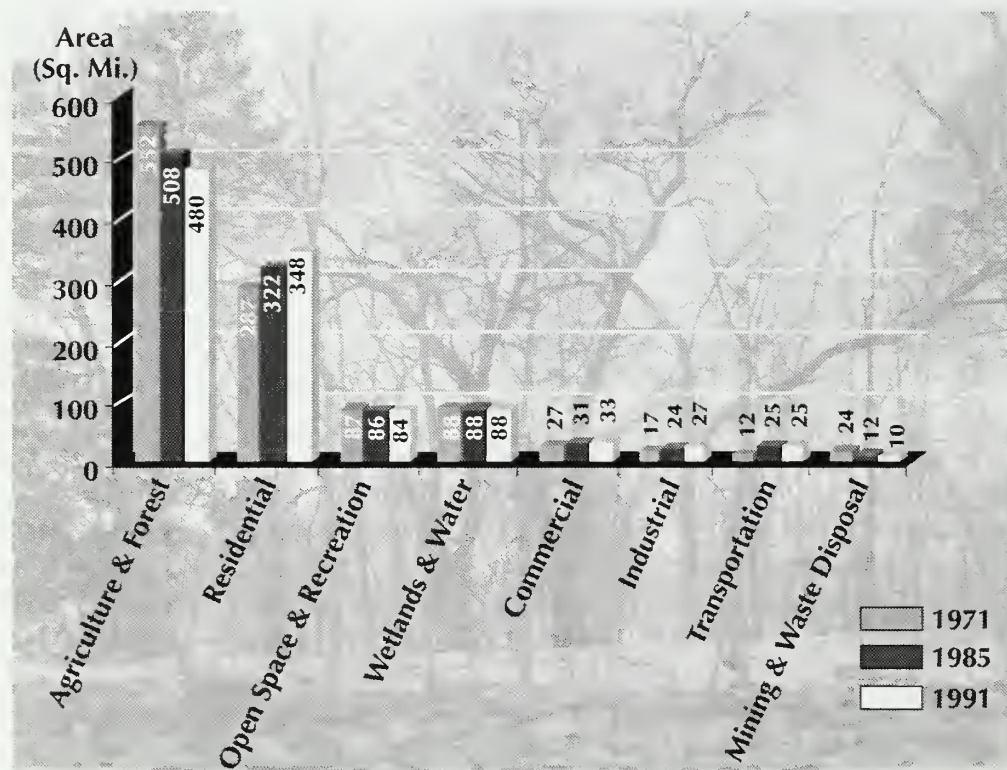
Boston Region (data compiled by MAPC, based on MacConnell Land Use Analysis of 68 MAPC communities).

Agricultural, forested, recreational, and open space land decreased by approximately 72 square miles across the region from 1971 to 1991. The

of 4 and 1/3 cities the size of Boston, while the population increase during this same time period was the equivalent of roughly 1/2 the City of Boston.

The dispersed development pattern that has occurred in the region has resulted in a loss of

FIGURE 2-1
Change in Land Use in the Boston Region
1971–1991



productive farmland, forestland and wetlands critical to the region's environmental health, as well as the loss of community character of local municipalities; increased air pollution from vehicles due to longer commutes (where there is no mass transit alternative), increased infrastructure and municipal costs, and the decline and abandonment of previously developed industrial/commercial sites closer to the inner core.

majority of this acreage has been developed as residential land (61 square miles) since 1971, with industrial (10 square miles) and commercial (6 square miles) development following. Most of this development is occurring in areas that were once forested.

Another survey, conducted by the Massachusetts Greenspace Initiative (212 municipalities, including all 164 in the regional model, plus others to the south and west) showed a 15% increase in land development in the region between 1970 and 1990. During the same time period the population of the region grew by only approximately 5%. To visualize this another way, the land area developed between 1970 and 1990 was the equivalent

The Massachusetts Audubon Society's "Losing Ground" second edition, 1999, reiterates and expands on the information provided above. The Audubon Society study found that from 1972 to 1996, developed land in Massachusetts increased by 59%, while the population grew by only 6%. The rate of land consumption declined from the 1980's, but still remains at roughly 16,000 acres per year. "Losing Ground" reports that three of the five most rapidly growing areas of the state are in Eastern Massachusetts:

- The northern portion of Southeastern Massachusetts,
- The Winchester/Stoneham/North Reading area, and

- A broad band along the entire length of Interstate 495.

A review of the MAPC/MacConnell land use data on the community level confirms that the majority of the residential growth is occurring along the Route 3 and I-495 corridors. The largest change in residential acreage has occurred along the South Shore in the communities of Duxbury, Hanover, Marshfield, and Pembroke as well as the communities of Acton, Carlisle, Franklin, Marlborough, Medway, and Norfolk in the western part of the region. There has been little change in the urbanized area in and around Boston. However, this does not account for significant redevelopment in some areas already designated as developed by the MacConnell inventory.

The majority of land being developed for industrial and commercial purposes is located along the Route 128 and I-495 corridors. Industrial growth along the Route 128 corridor is occurring in the communities of Wilmington, Woburn, Burlington, Stoughton, Randolph, Canton, Braintree, and Quincy. Industrial growth along the I-495 corridor is occurring in the communities of Milford, Marlborough, Hudson, Franklin, and Bellingham. The communities of Cambridge, Everett, Needham, and Waltham have actually lost industrial acreage over the past 20 years. Commercial property has grown in the communities of Burlington, Danvers, Peabody, and Woburn, all located along the Route 128 corridor.

The trend since the 1950s has been development outside of the urbanized Boston area and in the suburbs. The transportation network has helped to guide the development patterns in the region. Development will continue to grow in the suburbs as long as the transportation system can handle

the demand. Traffic on the interstate system continues to increase while the MBTA continues to expand its commuter rail system to also accommodate the demand. It is expected that the fastest growing communities in the Boston Region over the next twenty years will be those between Route 128 and I-495.

PLANNING FOR GROWTH

The transportation agencies have agreed to work with the state environmental, energy, and economic development agencies to advance a strategy which will encourage development to occur

in areas well served by transportation facilities. An Executive Order on Planning for Growth was issued by the Governor in April 1996. It declared that the Commonwealth should actively promote sustainable development in the form of (a) economic activity and growth supported by adequate infrastructure

without sacrificing environmental quality and resources, and (b) infrastructure development designed to minimize adverse environmental impacts from economic activity.

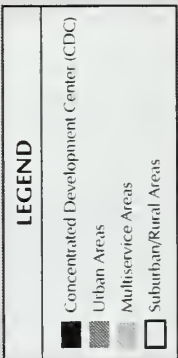
Under the Planning for Growth Program, the Executive Office of Environmental Affairs (EOEA) has established a statewide program to fund a buildout analysis for all communities by June 2001. This program will provide each community with a vision of its likely future based upon existing local and state regulations and the physical constraints of the community. This will allow communities to determine if they have the natural resources and infrastructure capacity to handle projected growth.

The results to date illustrate that substantial undeveloped land remains available for development



Rowley Commuter Rail Station on the Newburyport Extension

MAP 2-1



in the “outer communities” of the Boston Region, while growth in the “inner” core communities will occur largely through redevelopment. Executive Order 418, signed by the Governor early in 2000, directs EOEa, the Department of Housing and Community Development and EOTC to provide funds to assist the communities in following up on the buildout analyses to plan for housing, open space, economic development and historic preservation.

The Community Preservation Act (CPA), signed into law in September 2000, is a local option. It enables communities to establish a municipal Community Preservation Fund by local referendum. Monies collected for this fund are from a surcharge of up to 3% on local property taxes. The state will offer matching grants from the Community Preservation Trust Fund. Monies in the Community Preservation Fund may only be spent on open space, historic preservation, and community housing.

MAPC’s MetroPlan establishes guiding principles for development of the region. Implementation of MetroPlan’s interlocal component is being partially implemented through meetings of the eight MAPC subregions. The subregions meet on a regular basis to discuss topics including water resources, transportation priorities and open space protection. MetroPlan will be reexamined by MAPC in 2001.

CONCENTRATED DEVELOPMENT CENTERS

Through the coordination of MAPC, Concentrated Development Centers (CDCs) have been designated throughout the region. CDCs are areas designated to encourage higher-density development where adequate public facilities, including transportation, sewer, water, parks, and recreation, are already available. CDCs were developed during the MetroPlan planning effort. Directing development to these areas may reduce vehicle travel and energy consumption, and encourage economic development. Map 2-1 shows the areas that are currently designated as CDCs in the Boston region.

Transit-oriented development (TOD) is a technique that can help achieve concentrated development. TOD consists of a high-density, mixed-use, pedestrian-oriented environment with easy access to a transit station. Specific goals of TOD programs are to create high-quality living and working environments, improve station access, implement local land-use plans, and increase tax revenue. TODs offer the possibility of enhancing transit ridership, attracting private investment, improving the quality of the environment, and providing new or expanded employment opportunities in inner-city transit areas. A number of ongoing or proposed TOD projects are being implemented including a redevelopment project within downtown Salem which is a conversion of an abandoned industrial site to offices, retail and housing adjacent to an intermodal rail facility. A similar redevelopment project in Medford, Malden and Everett, known as Telecom City, will convert vacant industrial facilities to an office park capitalizing on the ease of access to the MBTA subway system.

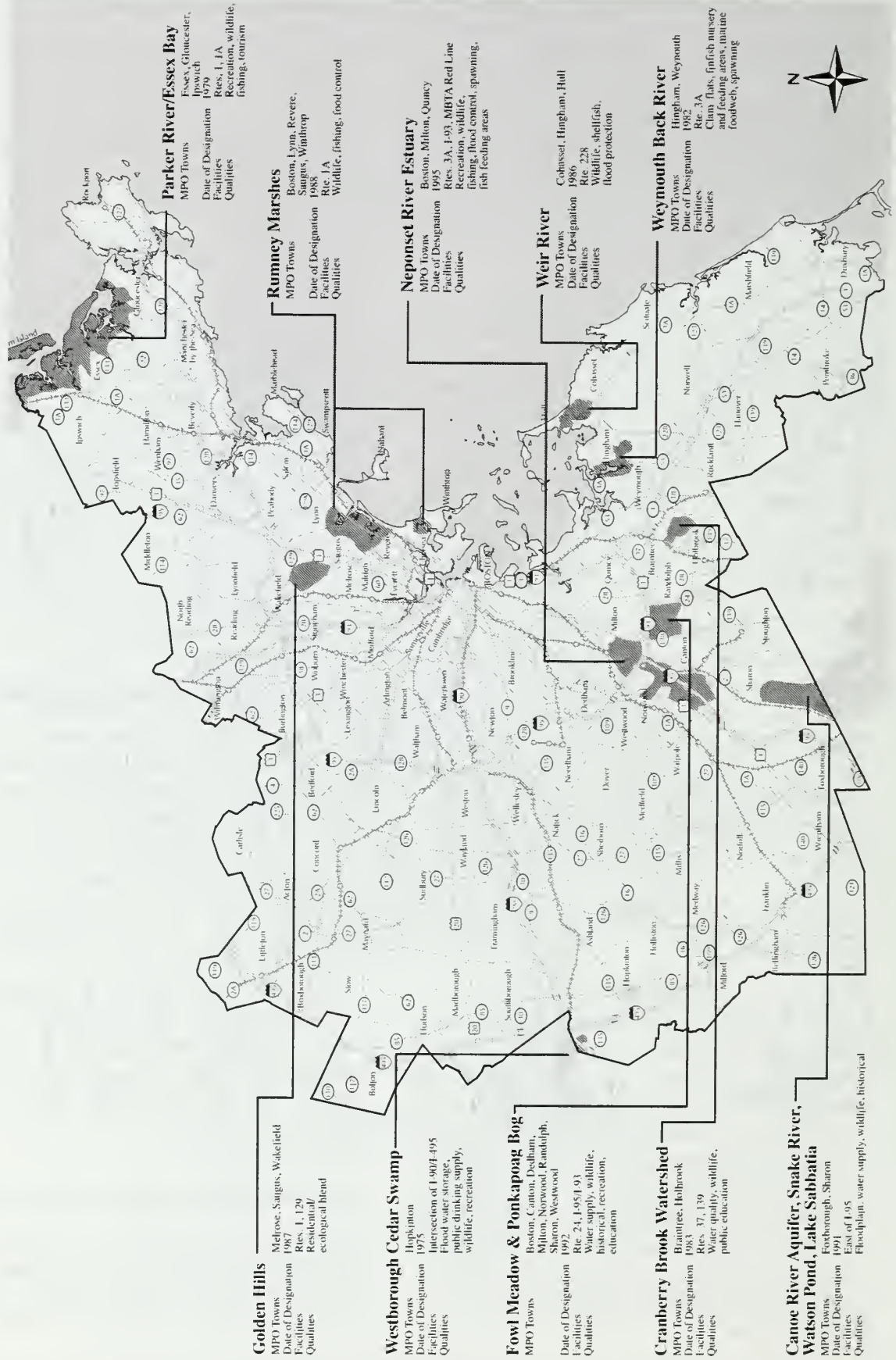
Areas of Critical Environmental Concern

An Area of Critical Environmental Concern (ACEC) is an area containing concentrations of highly significant environmental resources that has been formally designated by the Commonwealth following a public nomination and review process. The Commonwealth established legislation in 1975 that authorized and directed the Secretary of the Executive Office of Environmental Affairs (EOEA) to identify ACECs and develop policies for their preservation and management. Any transportation project that is to be constructed in or around an ACEC must follow the regulations so that the project does not impact the ACEC. The ACECs in the Boston region are shown in Map 2-2.

LAND USE SCENARIOS FOR THE PLAN

As part of the “visioning” process for the 2000 Regional Transportation Plan, we need to collectively, as a region, imagine what we want to be like in the year 2025, and how we want to get

MAP 2-2 Areas of Critical Environmental Concern



there. We began this process at the many public meetings held around the region in the last year with a discussion of alternative land use and transportation scenarios. The scenarios discussed at these meetings encompassed both a vision of the future and land use policies and transportation strategies that will help us achieve the vision.

From these discussions, three land use scenarios were developed by MAPC. These scenarios do not predict actual changes in land use in the region; they merely allocate forecasts of population, households, and employment, by Traffic Analysis Zone (TAZ) out to the year 2025. Scenario A, Trends Extended, assumes population, households, and employment will follow the general pattern of growth observed for the last 20 years. Water and Sewer Constraints, Scenario B, allocates future population and employment growth to communities with the water supply and wastewater infrastructure to accommodate it. A policy of targeting growth to denser areas with available water, sewer and transit infrastructure is the basis for Scenario C, Targeted Growth.

Please note these scenarios are merely projections to a possible future, not a prediction. No one is intended as “more likely” or “more realistic”. They are all based on assumed trends, which will surely change by the year 2025:

- Trends Extended – past growth areas will continue to be attractive, existing resources and infrastructure constraints are overcome and do not limit development, and large numbers of people will move to, or commute into, the Boston region (the 164 modeled communities) in response to large numbers of new jobs.
- Water and Sewer Constraints – current water and sewer supplies and technology will restrict development or make it too expensive in most communities, new technology will not significantly negate this constraint, and conservation programs will not significantly reduce total demand under current levels.
- Targeted Growth – effective policies and programs will be in place that will encourage

growth in areas that have appropriate infrastructure capacity and that can influence many of the location decisions made in the region.

Only the Trends Extended land use, plus the 2025 “committed” Build network described in Chapter 10, were used in developing this Plan. Since land use and transportation work together in shaping the region, all three scenarios will be combined with a number of transportation alternatives into a range of land use/transportation scenarios and evaluated in the 2001 update. The final scenario in the 2001 Plan, the future we design for, may be some combination of the best of all of three, or even something completely different.

How Was This Developed?

Scenario A – Trends Extended

Trends Extended, as the name implies, simply extends trends from the past 20 years on births, deaths, migration, household size, and employment out to the year 2025. No consideration is given to the likelihood of these trends continuing; of whether resources and infrastructure are available; or whether that level of economic growth is realistic for a community or the region.

All forecasts are first made at the community level. MAPC worked with all 101 communities in the Boston region to develop these estimates. Those for the remaining 63 communities in the modeled region were also based on extended trends, in consultation with the appropriate Regional Planning Agency. These community forecasts were then further disaggregated to TAZs based on past community-to-zone distributions.

The population forecast used the most recent 20-year trends in births, deaths, and migration. These population forecasts form the basis for the household forecast. Past trends in a community’s average household size, plus the populations living in group quarters, are applied to the population forecast to yield an estimated number of households in 2025.

Employment forecasts were developed using a “bottom up, top down” trends extended method. Community level trends (164) are aggregated to produce a regional growth trend for employment, which is extended to 2025 to produce a regional employment total. These regional totals are then disaggregated by community into 9 employment categories, and eventually into retail, service, and other employment for each of the 986 TAZs in the modeled region.

The above methods were used to produce a draft set of population, household, and employment forecasts for each community in the Boston region. These forecasts were distributed to the communities for comments. Based on the comments received, population or employment was changed for a community, and the regional totals adjusted. Scenario A: Trends Extended (Map 2-3) shows the forecast density for each TAZ under this scenario.

Scenario B – Water and Sewer Constraints

Under this scenario, development continues in a community at its Trends Extended pace until it reaches the capacity of existing (or currently planned) infrastructure. Remaining population and employment growth is allocated to communities that have the water supply and wastewater infrastructure to accommodate it.

Each community’s water supply capacity is based on their Water Management Act withdrawal permit. Current water use (average day) is based on the average annual water demand for the 5 most recent years available (1994-1998). Demand minus supply determines how much water is available in each community for future growth.

The 2025 water demand is estimated for the Trends Extended forecast growth in population and employment, based on a water use factor of 75 gallons per day per person, and 3 categories of water use factors for employment (basic, retail, services). Where towns do not have sufficient supply to meet 2025 demand, some of the population and employment growth is reallocated out of deficit towns, bringing each town down to the

level that its available water will support. Total population and employment for the region remains the same as under Trends Extended. Of the towns with year 2025 “surplus” water/sewer capacity, put the reallocated “deficit” town growth into those that have a significant surplus and adequate sewer capacity. “Surplus” towns are put into 3 categories:

1. “Water limited” (pale green) – towns that can accommodate 2025 growth, but do not have a significant surplus beyond 2025.
2. “Sewer limited” (brown) – towns that have a water surplus but do not have adequate sewer.
3. “Water and Sewer Capacity” – (blue) – towns have significant surplus water and sewer. Reallocate growth into these (MWRA communities, Plymouth, Andover).

Scenario B: Water and Sewer Constrained Communities (Map 2-4) shows the communities with “constrained” and “limited” water and sewer systems, as well as those with a deficit. The resulting densities by zones are shown in Scenario B: Water and Sewer Constrained Communities, TAZ Density (Map 2-5).

Scenario C – Targeted Growth

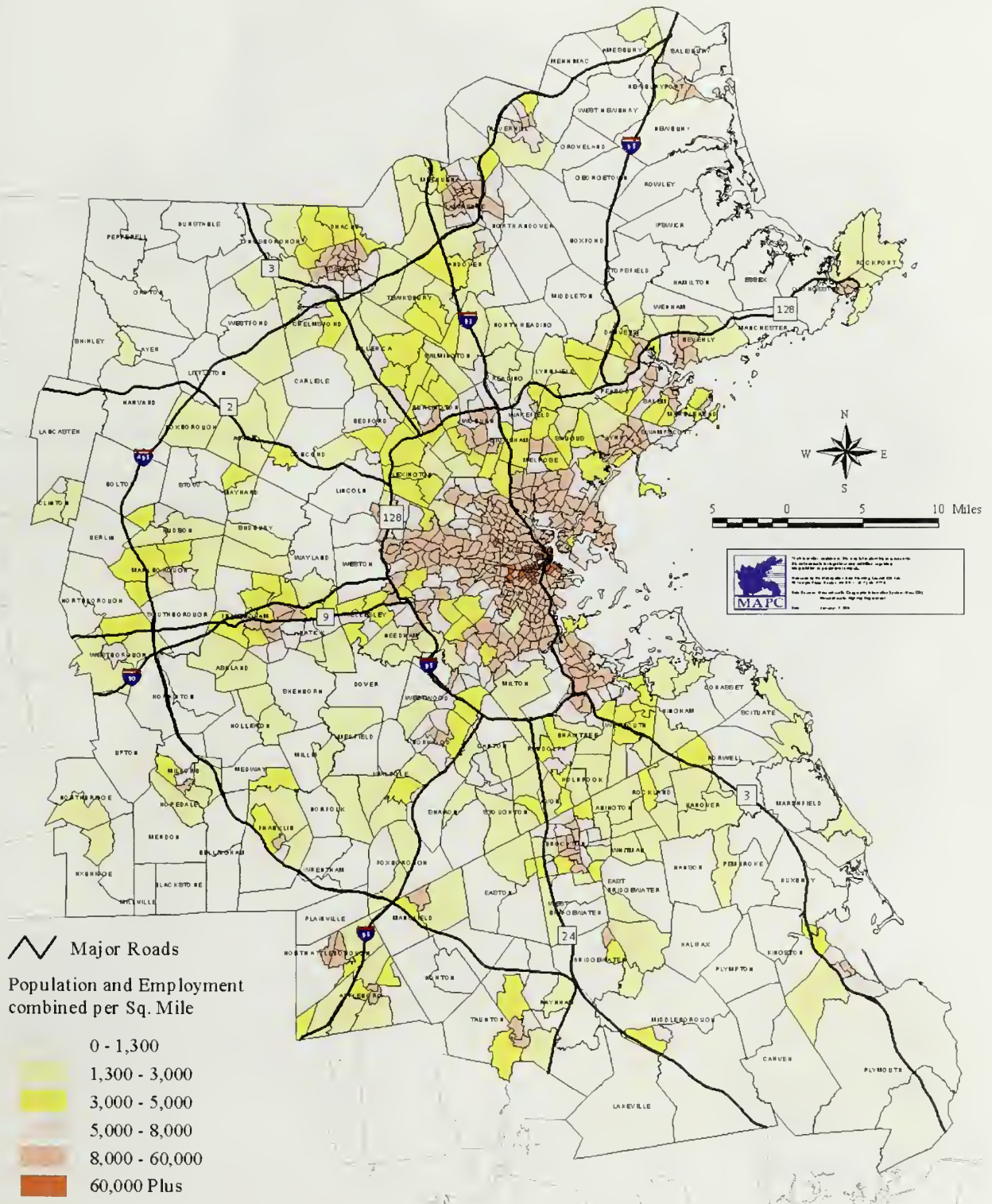
This scenario builds around the values of the adopted land use plan (MetroPlan) for the Boston region. Development is focused where infrastructure already exists and where the densest concentrations of population and employment already exist. Emphasis is placed on communities with Commuter Rail stations.

Job allocation is the same as in the Water and Sewer Constraints scenario. This is to emphasize that the “excess above water capacity” jobs have been relocated to the area most able to accommodate them - the MWRA zone which is also mostly served by transit and the radial commuter rail system.

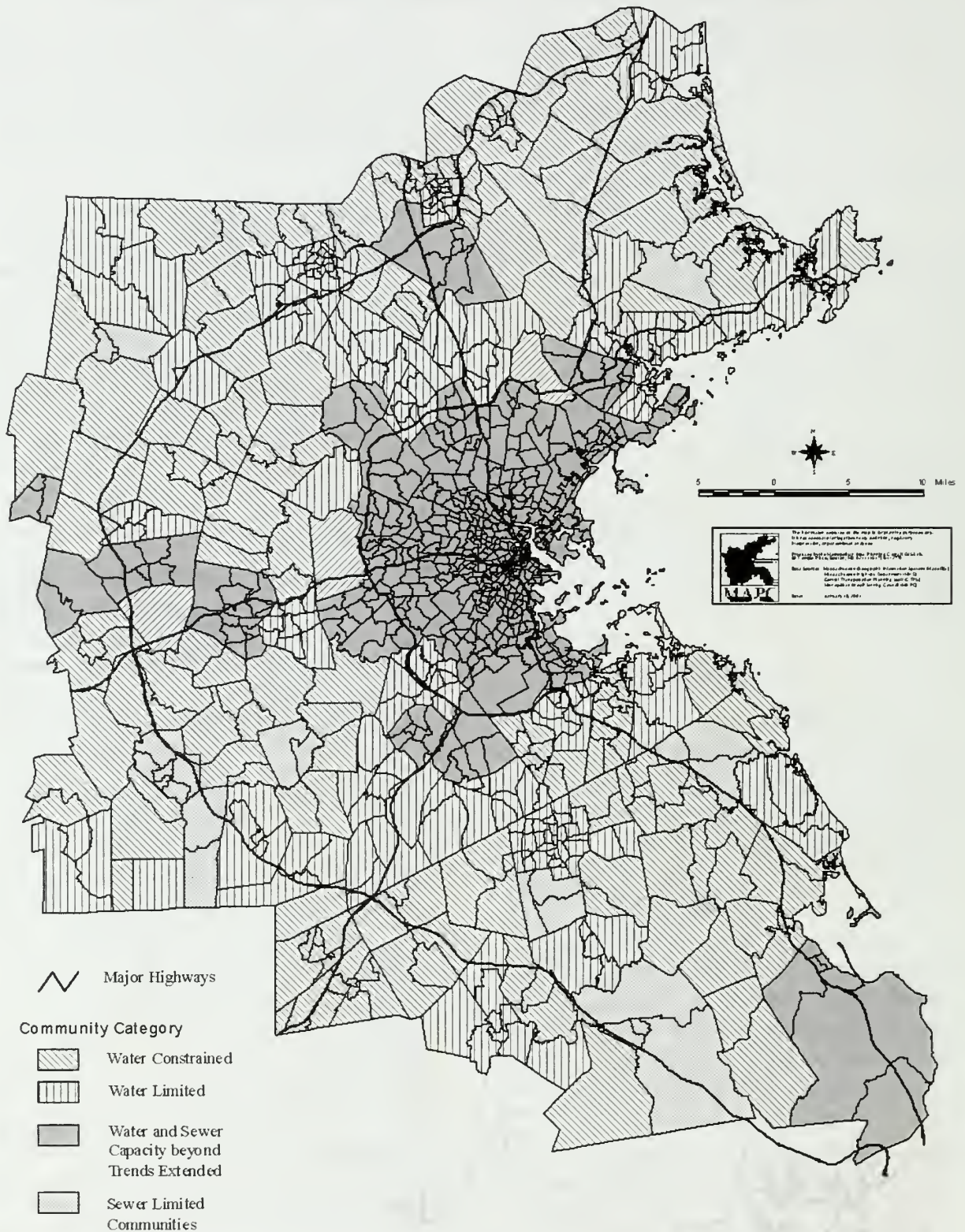
Growth in population and households by community is targeted based on the following principles:

- MWRA and Andover and Plymouth: Grow

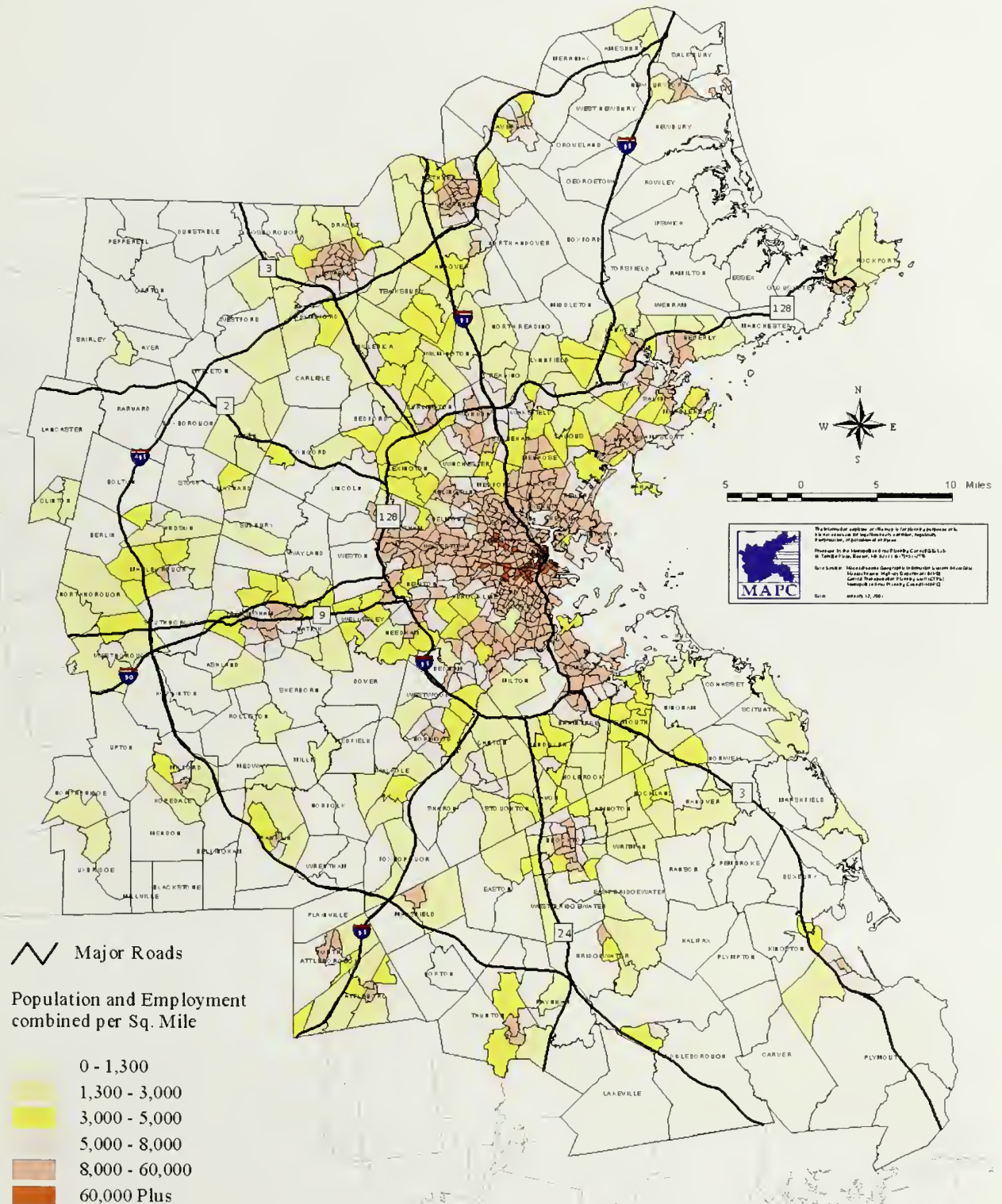
MAP 2-3
Scenario A: Trends Extended
Transportation Analysis Zones (TAZs)
Density Ranges for Combined Population And Employment Densities



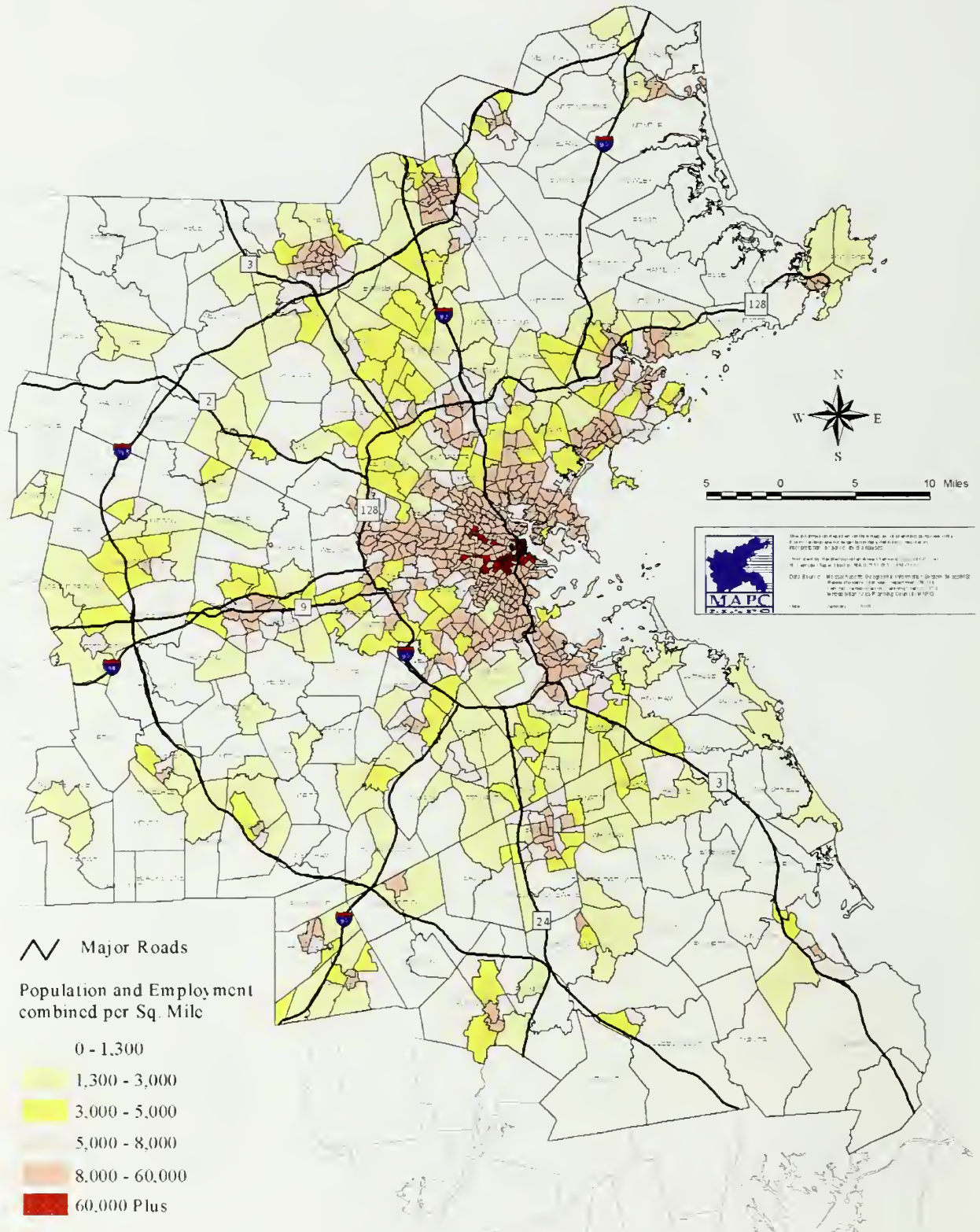
MAP 2-4 Scenario B: Water and Sewer Constraints



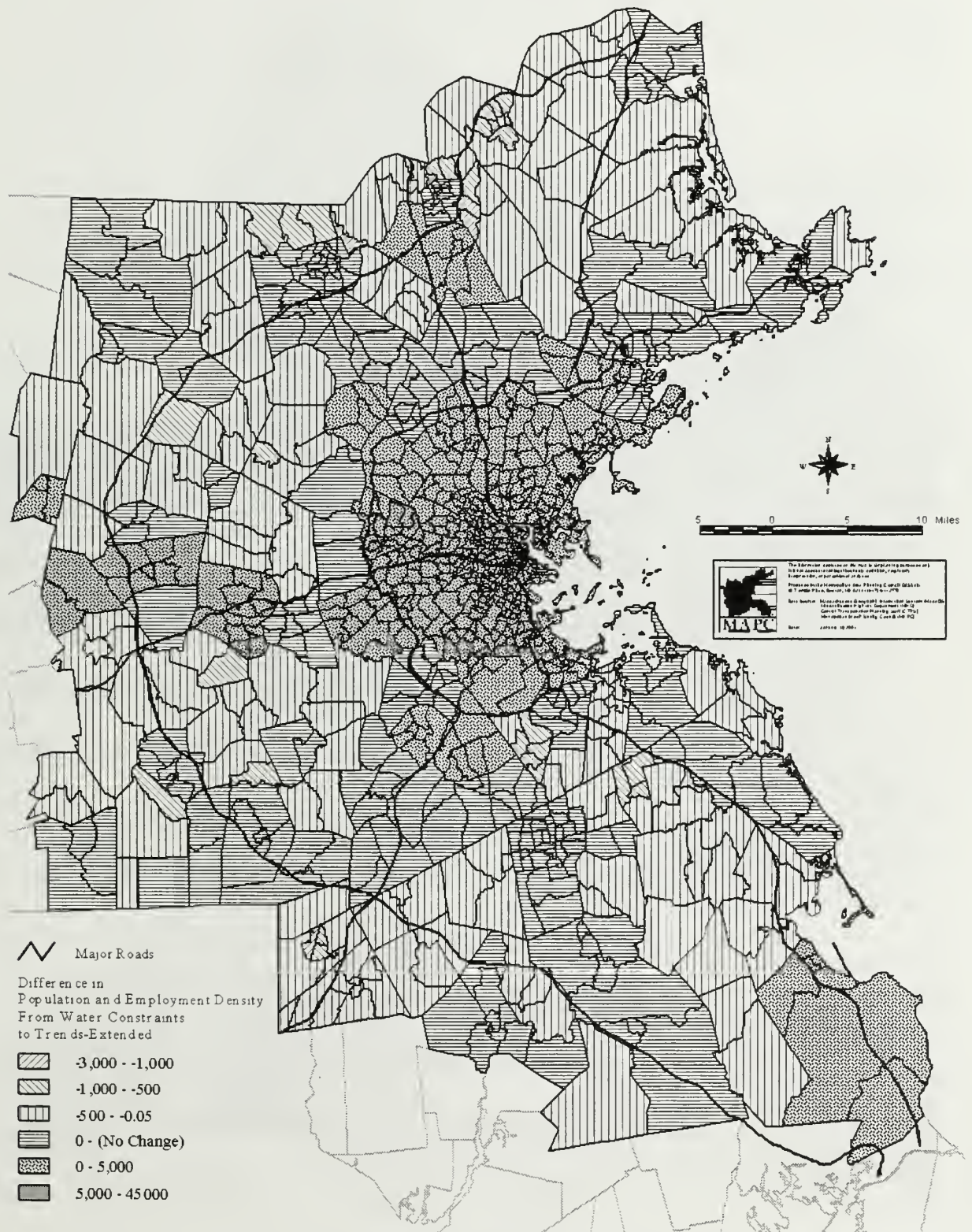
MAP 2-5
Scenario B: Water and Sewer Constraints
Transportation Analysis Zones (TAZs)
Density Ranges for Combined Population And Employment Densities



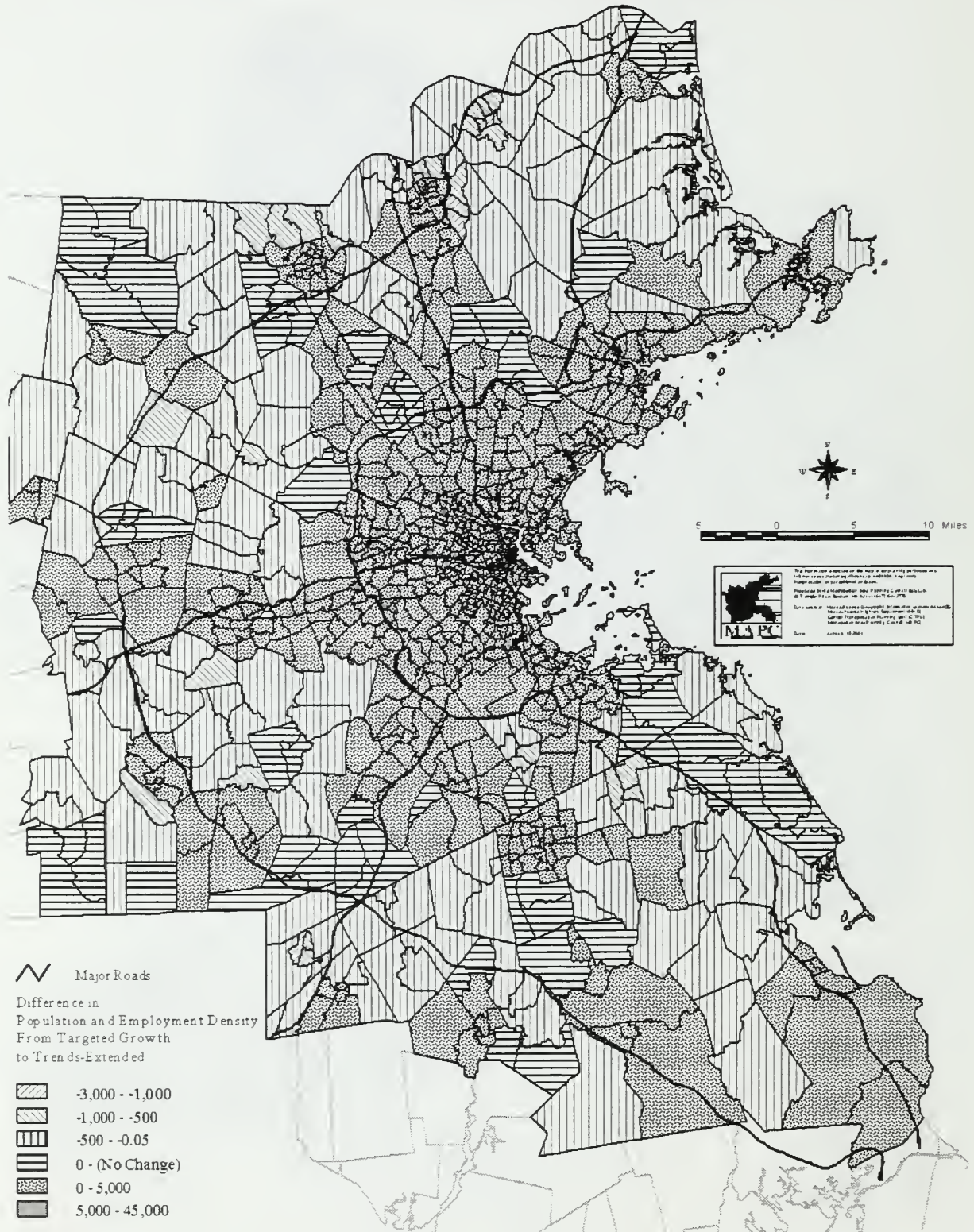
MAP 2-6
Scenario C: Targeted Growth
Transportation Analysis Zones (TAZs)
Density Ranges for Combined Population And Employment Densities



MAP 2-7
Water Supply Constraints Scenario
Difference in Population and Employment Density
From Water Constraints to Trends-Extended



MAP 2-8
Targeted Growth Scenario
Difference in Population and Employment Density
From Targeted Growth to Trends-Extended



the same as in Water Constraint Scenario (i.e., Trends Extended plus 7% additional population growth)

- Areas with additional water capacity and either existing Density or a Commuter Rail station: Population to grow as in Water Constraint scenario, then add 5% more population (using the year 2000 as base population), but limit total growth to the water capacity level.
- Area with no additional water capacity and a Commuter Rail station: Since these areas are already water constrained, assume only an additional 3% growth (using the year 2000 as base population), and assume that this will be

off-system growth or through water conservation measures.

- In areas water capacity and with density and commuter rail: Population to grow as in Water Constraint Scenario and then add 10% more population (using the year 2000 as base population) but limit growth to water supply capacity.
- Non-water limited areas without density or commuter rail: Grow as in Water Constraint Scenario (i.e., to Trends Extended growth that is not limited by water).
- Water limited areas without commuter rail: Grow as in Water Constraint Scenario to limit of water availability.

TABLE 2-1
Largest Changes in Population and Employment for Trends Extended Scenario

Community	% Change Population 1990-2025	Community	% Change Employment 1995-2025
Ayer	-18.24	Maynard	-11.86
Winthrop	-16.88	Lynn	-3.81
Arlington	-15.64	Harvard	-3.21
Dedham	-14.45	Lawrence	-1.12
Melrose	-13.66	Clinton	-0.47
Watertown	-12.85	Brockton	-0.25
Weymouth	-8.24	Groton	0.31
Holbrook	-6.56	Blackstone	3.89
Brockton	-4.28	Wayland	4.18
Belmont	-4.00	Gloucester	4.39
Boxborough	133.64	Boxborough	253.96
Millville	116.68	Carver	147.26
Hopkinton	99.68	Bolton	118.28
Bolton	96.26	Tyngsborough	105.73
Dunstable	89.46	Dunstable	105.63
Lakeville	85.25	Lakeville	103.66
Franklin	84.67	Westford	103.12
Groton	84.01	Bellingham	102.39
Boxford	82.19	Hopkinton	91.60
Mansfield	81.01	Halifax	91.31
Average for Region	17.46%	Average for Region	31.19%

The above allocations allow regional population growth for 2025 to be larger than those under the previous two scenarios.

The resulting population and employment densities under this scenario are displayed in Scenario C: Targeted Growth (Map 2-6).

What This Shows

Under the Trends Extended scenario, development will occur mostly in the fringes of the area, probably on currently undeveloped land, particularly along I-495. In addition to the communities shown in Table 2-1, communities such as Dra-cut, Plymouth, Marlborough, and Chelmsford all are forecast to experience significant growth. Many of the communities losing population are the inner suburbs, while older cities tended to be those forecast to lose employment.

TABLE 2-2
Water and Sewer Constraints Scenario Changes
Versus Scenario A

Community	Change in Population v. Scenario A	Community	Change in Employment v. Scenario A
Boston	39,748	Boston	24,759
Cambridge	6,650	Cambridge	4,999
Quincy	5,830	Waltham	2,847
Lynn	5,596	Newton	2,091
Newton	5,461	Quincy	2,039
Somerville	5,220	Framingham	1,841
Framingham	4,464	Woburn	1,726
Waltham	3,937	Andover	1,392
Medford	3,894	Marlborough	1,187
Brookline	3,882	Peabody	1,141
Dracut	-9,993	Boxborough	-4,260
Haverhill	-9,127	Weymouth	-3,376
North Andover	-7,991	North Andover	-2,965
Carver	-5,912	Rockland	-2,799
Lakeville	-5,027	Norton	-2,599
Methuen	-4,939	Concord	-2,450
North Attleboro	-4,915	North Attleboro	-2,191
Tyngsborough	-4,883	Tyngsborough	-2,188
Ashland	-4,766	Westford	-2,185
Norton	-4,545	Raynham	-2,130
Total Population Reallocated for Region	154,461	Total Employment Reallocated for Region	62,066

Tables 2-2 and 2-3 compare the Water and Sewer Constraint and Targeted Growth scenarios to the Trends Extended, Scenario A. Maps 2-7 and 2-8 display the changes for each zone.

Most of the available water and sewer capacity is in the MWRA communities. As shown in Table 2-2 all of the communities with the largest increases in population and employment under Scenario B are MWRA, except Andover. Most of the high growth communities in Trends Extended on the other hand, do not have the sufficient water capacity to support that level of growth. Under Scenario B, their growth is greatly reduced, although all communities still grow relative to the current population and employment levels.

TABLE 2-3
Communities with Largest
Additional Population
Increases Scenario C versus
Scenario B

Community	Population Increase, Scenario C versus B
Lowell	10,535
Brockton	9,191
Lawrence	6,204
Salem	3,662
Beverly	3,034
Gloucester	2,179
Franklin	1,959
Braintree	1,774
Haverhill	1,717
Weymouth	1,592
Natick	1,566
Newburyport	1,491
Milford	1,303
Billerica	1,262
Attleboro	1,235
Danvers	1,232
Reading	1,190
Dedham	1,126
Wilmington	1,061
Middleborough	1,001
Total Reallocated for Region	68,839

Under the Targeted Growth Scenario, most communities' population and employment numbers match those of Scenario B. In addition, some population has been moved to targeted communities with commuter rail available. In addition to reallocating population within the 164 model communities, 66,000 persons (roughly 30,000 households) who would have lived outside the region but worked inside are now assumed to live within as well.

AIR QUALITY

Status of Air Quality in the Region

The Boston region has historically been classified as serious nonattainment for ozone. Ozone is formed when volatile organic compounds (VOC) and nitrogen oxides (NOx) mix in the presence of sunlight. With this ozone nonattainment classification, the 1990 Clean Air Act Amendments (CAAA) required the Commonwealth to develop a State Implementation Plan (SIP) which outlined a strategy of programs to reduce VOCs, NOx and carbon monoxide (CO). In addition, the 10 communities of Boston, Cambridge, Chelsea, Everett, Malden, Medford, Quincy, Revere, Somerville and Waltham were classified as nonattainment for CO.

The Massachusetts Department of Environmental Protection (DEP) is the agency charged with developing the SIP. It has implemented a number of programs to reduce emissions from mobile sources and bring the Commonwealth's air quality into attainment. These programs include an Enhanced Automobile Inspection and Maintenance Program, a Low Emission Vehicle Program, and an Alternative-Fuels Program.

Existing Technological Mobile-Source-Emission-Reduction Programs in the Boston Region

Enhanced Automobile Inspection and Maintenance Program

The CAAA required the Commonwealth's original automobile emissions testing program to be

upgraded to a new "high-tech" test. The Commonwealth began testing vehicles in October 1999 under this new program. The enhanced testing requires all automobiles, trucks, and buses to be inspected using an advanced computerized



Inspection station

system called a dynamometer (a treadmill for cars) that simulates real-world driving conditions. In addition to emissions like hydrocarbons and CO, the enhanced test measures, for the first time, NOx. Emissions tests are now required every two years instead of every year, because the new test is more accurate than the program it replaced.

The safety test is still required annually.

Low Emission Vehicle Program

DEP has established the Massachusetts Low Emission Vehicle (LEV) program. The LEV program promotes the use of cleaner vehicles to reduce emissions of air pollutants such as CO, VOCs and NOx. The program requires that all new passenger vehicles sold in Massachusetts meet a cleaner, California motor-vehicle-emission standard.

In December 1999, the Commonwealth promulgated LEV II, the next stage of the California LEV program. LEV II phases in more stringent emission standards for light- and medium-duty vehicles. It applies new exhaust, evaporative, and fleetwide average standards to all passenger vehicles and, for the first time, requires that most sport utility vehicles and light-duty trucks meet the same standards. Light-duty vehicles (under 6,000 pounds) must comply with the LEV II standards starting with model year 2004. The LEV II standards for medium-duty vehicles (6,000 to 14,000 pounds) take effect with model year 2003. LEV II also requires manufacturers to bring

advanced vehicle technologies to the market. Starting in 2004, 10% of all vehicles available for sale in Massachusetts must be zero-emission vehicles (ZEV) or partial ZEVs.

Alternative-Fuels Program

Alternative fuels are an important component of the LEV program and the Energy Policy Act adopted by Congress in 1992. As outlined above, the LEV program requires vehicles to meet increasingly stringent emission standards in the coming years. The Energy Policy Act sets guidelines for the acquisition of new light-duty vehicles for federal and state fleets requiring that certain percentages of new vehicles be alternatively fueled.

Automobile manufacturers are introducing alternative-fuel vehicles into their fleets in order to meet the more stringent emission standards and requirements being set by federal and state governments. Natural gas, electric, and, most recently, hybrid electric vehicles are emerging into the marketplace. Currently the Commonwealth's state-owned fleet includes 235 alternative-fuel vehicles. Of these vehicles, 133 are fueled by compressed natural gas, 82 are powered by electricity, 3 are fueled by propane, and 17 are ethanol/gasoline flexible-fuel vehicles. They are owned and operated by the following agencies.

- Massachusetts Port Authority – 59 vehicles
- Massachusetts Bay Transportation Authority (MBTA) – 19 vehicles
- Massachusetts Water Resources Authority (MWRA) – 12 vehicles

- Massachusetts Turnpike Authority – 5 vehicles
- Operational Services Division – 119 vehicles
- UMASS/Boston – 21 vehicles

The MBTA has explored different options for converting all or parts of its bus fleet to alternatively fueled buses. A pilot program tested two types of vehicles: diesel-electric hybrid and compressed natural gas. The MBTA reviewed data from this program on the operation of the vehicles and customer satisfaction and decided on compressed natural gas as being best suited for future MBTA service.

Fueling infrastructure for alternative-fuel vehicles is continuing to be built throughout the Commonwealth. Today, Massachusetts has 11 compressed

natural gas refueling stations in operation that can be accessed by the public, and an additional 7 stations are planned to be built over the next two years. In addition, twelve electric charging stations are located in two MBTA parking locations (Braintree and Alewife) to support the electric vehicle demonstration program



Alternative-fuel bus

that is being conducted by the Massachusetts Division of Energy Resources. Construction of fueling infrastructure will be necessary to ensure the future success of the Alternative-Fuels Program.

In September 2000, the secretaries of EOTC and the Executive Office of Environmental Affairs (EOEA) signed a consent order that mandates the completion of several transit projects within a set timeframe. The mandated projects cost a combined \$2 billion and consist of studies, construction projects and vehicle procurements. Most of the projects outlined in the consent order were

commitments made during the permitting of the Central Artery project.

The new programs have helped improve the air quality in the Boston region. In April 1996, the nine communities of Boston, Cambridge, Chelsea, Everett, Malden, Medford, Quincy, Revere, and Somerville were classified as attainment for CO; however, they remain in maintenance status for the next 20 years. This means that the Commonwealth must show that the communities continue to meet the CO standard over this period. Waltham, however, remains in nonattainment for CO.

Transportation Agencies' Contribution to Improved Air Quality in the Boston Region

Transportation Project Commitments in the State Implementation Plan

MassHighway has committed to funding projects throughout the Commonwealth that improve the flow of traffic and thereby reduce congestion and improve air quality. The following is a partial list of types of projects that have been implemented by local and state highway departments that improve traffic flow in the region:

- Intersection improvements, including channelization, signalization, and signal retimings
- Signal coordination at consecutive intersections
- Parking prohibitions
- Capacity increases through widening roadways or restriping existing pavement
- Curb cut consolidation

In addition as part of the approval of the Central Artery project, the Executive Office of Transportation and Construction committed to implementing specific transportation improvement projects that contribute to improved air quality. These projects became part of the State Implementation Plan. The majority of these projects are

being implemented by MassHighway and the MBTA. A partial listing includes:

- South Station Bus Terminal construction
- Newburyport Commuter Rail Extension
- Old Colony Commuter Rail Extension
- Framingham Commuter Rail Extension to Worcester
- 20,000 new park-and-ride spaces
- Interstate 93 Southbound HOV lane to Mystic Avenue
- Southeast Expressway HOV lane from Savin Hill to Route 3

Over 70% of the Central Artery-related transportation commitments have been completed. It is expected that most the remaining commitments will be in place by the Artery's completion in 2004.

In June of 1999, the United States Environmental Protection Agency (EPA) revoked the 1-hour standard for ozone in the Eastern Massachusetts ozone nonattainment area because monitoring of the air quality in this region showed that the 1-hour ozone standard had not been exceeded over the last three years. Currently, the Boston Region is in attainment for the 1-hour standard. EPA has, however, proposed that a new 8-hour standard replace the 1-hour standard. Once this standard becomes effective, the Boston Region will most likely be classified as nonattainment for the 8-hour standard based on past monitoring data. However, in October 1999, due to a recent court ruling on the 8-hour standard, EPA proposed to rescind the findings to revoke the 1-hour standard. This rescission will be effective in Eastern Massachusetts on January 16, 2001. Therefore, this plan will determine ozone and CO conformity using the 1-hour standard.

Performance Measures for Transit Service Quality

A major goal for air quality improvement is to get people out of their single-occupant vehicles and into carpools, vanpools, public transportation, and

bicycles. Important to encouraging that change in travel behavior is assuring that transit service performs at acceptable levels. In order to do this, the MBTA's Service Planning Department continues to evaluate improvements to the existing service and to provide service expansions.

The MBTA collects ridership data throughout the system, enabling it to identify excess capacity and other resources and direct them to the routes and locations at the times when they are most needed. One example of the effectiveness of this service planning effort is that, without an enlargement of the bus fleet, annual bus ridership on the MBTA has increased from 92 million passengers in 1993 to 107 million in 2000.

Transportation Demand Management Programs

The Boston Metropolitan Planning Organization annually funds Transportation Demand Management (TDM) projects through the Congestion Mitigation and Air Quality Improvement (CMAQ) funding category of the Transportation Improvement Program (TIP). Funding is earmarked for projects, sponsored by public agencies, that will help the Commonwealth in improving its air quality. Specific TDM projects that have been funded in the TIP include shuttle services, park-and-ride lots, and bicycle projects. Transportation Management Associations (TMAs) are other recipients of MPO funding. TMAs are private, nonprofit groups formed to facilitate private-sector involvement in addressing transportation issues. At present, of the twelve TMAs operating within the Commonwealth, nine

are in the Boston MPO region. These include the 128 Business Council, Artery Business Committee TMA, Charles River TMA, Commute-Works/MASCO, Interinstitutional TMA at BU Medical Center, Logan TMA, MetroWest/ 495 TMA, Neponset Valley TMA, and the Seaport TMA.

High-Occupancy-Vehicle Programs

High-occupancy-vehicle (HOV) lanes are highway lanes dedicated to vehicles with two or more passengers. HOV lanes provide an incentive to form carpools or vanpools or take a bus, since these modes avoid congestion on general-purpose lanes and enjoy reduced travel time into the city during HOV lanes' hours of operation. MassHighway has constructed two HOV lanes on major highways leading into the City of Boston. One is

on I-93 southbound from Mystic Avenue to the Central Artery. Vehicles in the lane are required to have at least two occupants between 6:00 a.m. and 10:00 a.m. on weekdays.

The other HOV lane runs for six miles, from Furnace Brook Parkway in Quincy to Freeport Street in Boston. Opened in November 1995, it is

a contraflow lane that operates in the northbound direction during the morning peak period and in the southbound direction during the afternoon peak period. On weekdays, this lane is open only to vehicles with at least two persons between the hours of 6:00 a.m. and 10:00 a.m. northbound and 3:00 p.m. and 7:00 p.m. southbound. Both the I-93 and Southeast Expressway HOV lanes were constructed as mitigation measures for the Central Artery project.



CONCLUSION

Policy-makers at the local and state levels make decisions that impact both the built and natural environments. The connection between land use decisions and the environment has long been obvious. In recent decades policy-makers have begun to consider the connection between transportation investments and the effect they have on the environment and land use patterns.

The Boston MPO needs to take a leadership role in helping residents and policy makers better understand the transportation and land use connection, so that future investments do not contribute to further degradation of the environment. Despite the absence of full coordination between agencies or between state and local officials, the Boston region still possesses numerous and expansive natural treasures. In order to ensure that these are preserved without frustrating the economic viability of the region, the MPO and its agencies need to improve coordination with the Executive Office of Environmental Affairs, the Department of Environmental Protection, and the Executive Office of Community Development. Improved partnerships among state agencies should result in more efficient use of both land and transportation funding. The Commonwealth must also continue to strengthen cooperation with local officials through programs like Planning for Growth and Executive Order 418. Efforts should be made to build upon programs that provide incentives to both automobile owners and manufacturers to do their part to protect our region's air quality. And all stakeholders should be included in a discussion of the alternate land use scenarios developed by MAPC, as well as their implications, so that transportation policies are pursued that give the Boston region the best opportunity for maintaining and enhancing the quality of life for our residents.



CHAPTER

3

DEMOGRAPHICS OF THE REGION

This chapter looks at four main demographic statistics: population, households, employment, and automobile ownership. These four sets of statistics give a snapshot in time of how the region has developed and the mobility of its residents.

Unless otherwise noted, all references to the Boston region in this chapter are to the 101 cities and towns that make up the Boston Metropolitan Planning Organization region. The map on the following page shows these communities. The map distinguishes between three demographic subareas used for analysis in this chapter:

- Urban core (14 cities and towns)

Includes 14 cities and towns: Arlington, Belmont, Boston, Brookline, Cambridge, Chelsea, Everett, Malden, Medford, Newton, Revere, Somerville, Watertown and Winthrop.

- Route 128 subregion

Extends from the edge of the urban core through the communities that border Route 128

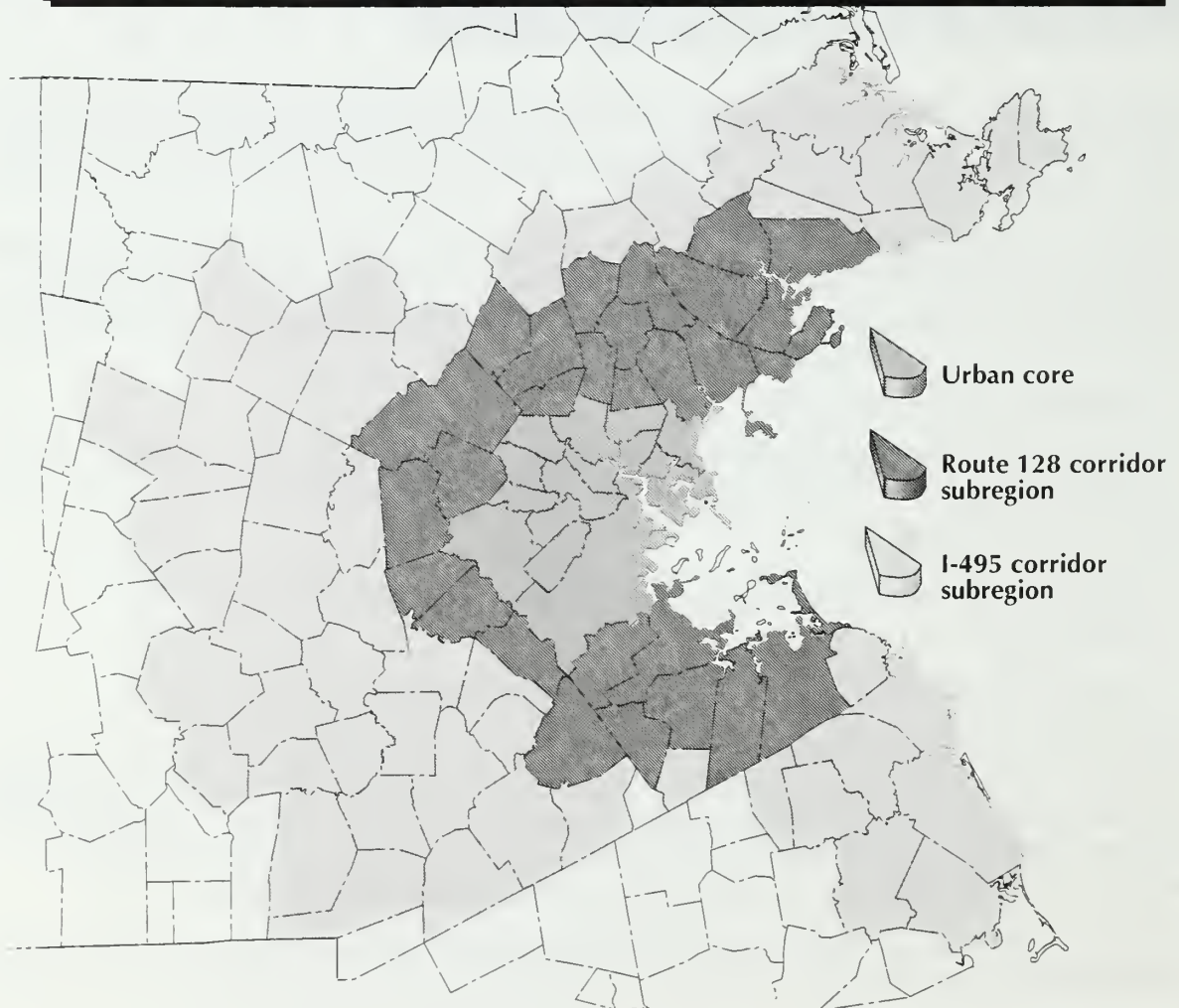
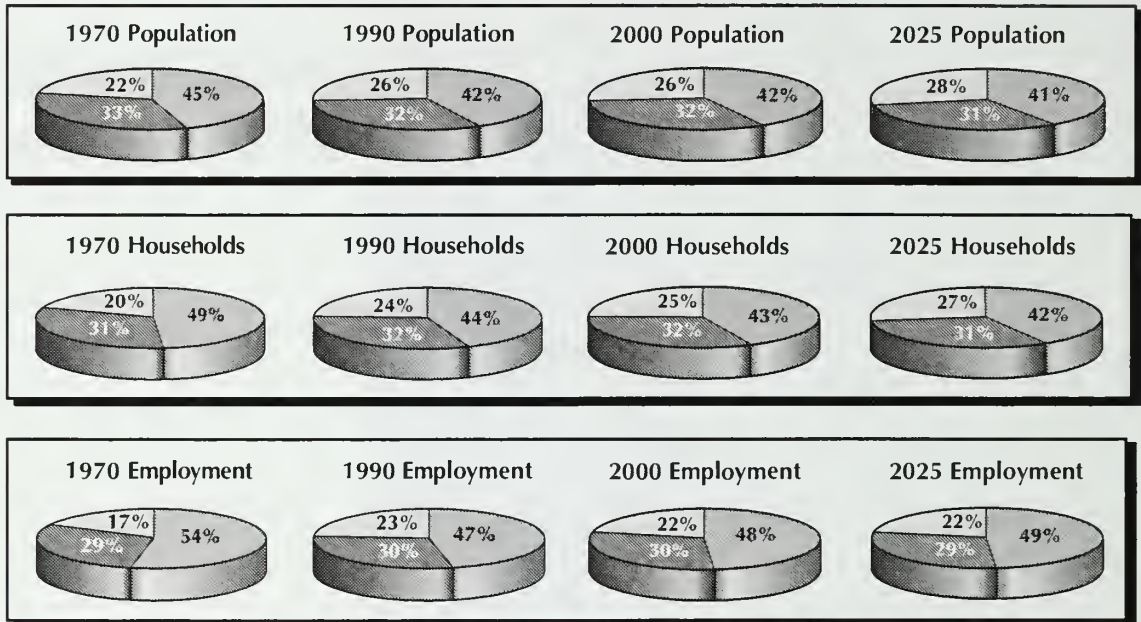
- I-495 subregion

Includes all the region's communities that are outside the Route 128 subregion

Much of the data used for this chapter is derived from U.S. census data. Unfortunately, the last census took place in 1990, so many of the statistics used here may be dated; however, they are the most reliable information available. Data from the new 2000 Census is not yet available. Chapter 9, Forecast of 1995 Base Case and 2025 No-Build Scenarios, uses 1995 estimates and 2020 projections for population, employment, and households for the region to project future conditions for the region.

It should be noted that much has changed in the region during the 1990s since the last U.S. Census. The decade began with the economy in a regional and nationwide recession during 1990 and most of 1991.

FIGURE 3-1
Demographic Shifts in the Boston Region



Since that time, the nation has been experiencing the longest period of economic prosperity in the past 100 years. As of January 2000, unemployment for the nation and the Boston region are at 30-year lows. But what has not changed over the last decade are the trends for the region that started in the 1950s. These include a continuation of migration of population and jobs to the suburbs and a dispersion of trips by residents.

RELATIONSHIP OF TRANSPORTATION AND LAND USE

Transportation and land use have a symbiotic relationship. A new transportation infrastructure development, such as a new interstate or commuter rail line, can cause a rural area to transform into a suburban area with increases in housing and employment. Likewise, an increase in population or employment in a sparsely settled area can impose demands on the transportation network that require new infrastructure to be built. The prospect of cheaper land often may be a determining factor in locating a new suburban office park or industrial center. This in turn imposes demands on the transportation system to improve access to new development.

The development of the interstate highway system beginning in the 1950s greatly increased the mobility of the American population and opened vast areas of the country to new development. Zoning regulations and cheaper land for housing and employment centers led to the development of suburbs north, west, and south of the traditional urban core of the Boston region. This led to a dispersion of jobs and housing from the urban core to suburban and rural areas.

One of the main problems with this dispersion is the difficulty in efficiently serving the transportation needs of all of the people of the region. In order for transit to succeed, it requires a concentration of households and a concentration of destinations, whether they be work, shopping, or schools. Dispersed development patterns cost more for roadway construction, increase driving costs, create additional air pollution and result in a conversion of open space to developed land. As

this concentration of people and destinations disperses, the ability to serve people decreases.

The use and increased availability of the automobile has increased mobility and local suburban zoning ordinances have encouraged less dense concentrations of people and employment. The population living in the traditional inner core shrank from 60% in 1950 to 42% in 1990. There has been a steady migration of people out of the urban core and into first the Route 128 region and then to the I-495 region. The growth of population in the past decade has been especially pronounced to the west and northwest of the urban core.

As these low-density development patterns have been replicated by newer suburbs in the I-495 region, a significant amount of housing has been constructed beyond the MPO's boundary. Constraints on municipal water and sewer systems are other factors that have driven growth beyond I-495. Many towns that lie outside of the Massachusetts Water Resources Authority's service area face real limits that will prevent them from growing at current rates for more than a couple of decades. As zoning or infrastructure constraints continue to push residential growth beyond the I-495 corridor there becomes less that MPO agencies can do to efficiently move residents between home, jobs, and shopping, not only in the traditional urban core, but also to employment centers along Route 128.

From the standpoint of cities in the core these constraints on growth in the suburbs may prove to be a blessing. In past decades there has already been a significant reversal in many of the trends that had typified the decline of older urban areas. Homebuyers frustrated by the time necessary for suburban work commutes, and the lack of modal choice in making those commutes, have begun to invest in older urban communities. The population of the city of Boston increased for the first time since World War II when the 1990 census showed an increase from 562,896 in 1980 to 574,283. Boston neighborhoods from Charlestown to Roxbury have seen significant portions of their housing stock renovated by new

residents attracted in part by the easy access via transit or walking to employment and shopping. In the case of urban neighborhoods where major transit investments have been made, such as East Arlington, West Somerville and North Cambridge along the 1980's extension of the Red Line, the infusion of investments by business and home owners has been nothing short of dramatic. And as the alternative increasingly becomes housing in ever-distant suburbs with few if any transit options, Boston and other urban core communities should continue to be able to build on the opportunities that their transportation infrastructure and density provide. Although the population continues to disperse, the center of the metropolitan area is no longer being abandoned.

POPULATION

The population of the Boston region has remained fairly constant for the past four decades. According to the U.S. Census, from 1970 to 1990 the population of the Boston region decreased by 3%, from 3.01 million to 2.92 million. Mid-decade estimates (1995) of population for the region show it returning to the 3 million level. This is during a time when the United States as a whole is growing. The U.S. population grew by 13% from 1980 to 1992.

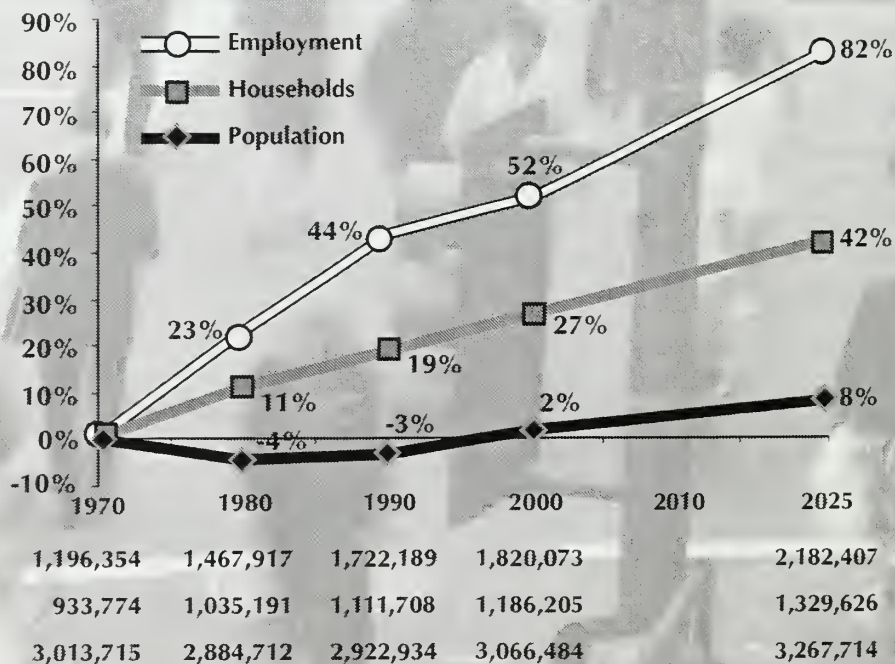
What has not remained constant is where the residents live within the region. There has been a dramatic shift in population from the urban core to the suburbs. In 1950, the population of the city of Boston

was 801,000. The 1995 population is estimated at 564,000, a decline of almost 30%. This phenomenon of movement of people and employment out of the urban core and to the suburbs has created a pattern of development dubbed "suburban sprawl" that has been repeated across all areas of the United States.

In 1950, most of the population of the region lived in Boston, the cities adjacent to Boston, or communities along the Massachusetts Bay coast. This was before the time of the interstate highway network. Route 128 was not yet built, and the fastest way to travel into Boston from the suburbs was by commuter rail. The decade of the 1950s saw the construction and completion of Route 128, the Massachusetts Turnpike, the Central Artery, the extension of Route 3 North and South, and Route 24.

By 1960, the populations of Boston, Cambridge, Somerville, Revere and Medford had experienced declines in population from 1950 levels, while virtually every community along the newly opened Route 128 and Route 3 North had growth in population. The improved access provided by

FIGURE 3-2
Changes in Demographics in the Boston Region



new highways made life in the suburbs more desirable for those who could afford the move. The cost of land and housing in the suburbs was cheaper than that of comparable housing in the urban core.

Between 1960 and 1970, population continued its migration away from the urban core. The communities experiencing the fastest growth in population were no longer those along Route 128, but further away from the urban core. By this time, Route 3 South had been extended, I-93 North had been constructed, and parts of I-495 were under construction. The ring of communities outside of Route 128 were undergoing the transformation from rural to suburban communities.

By 1980, the outer suburban areas continued growing, while almost all communities within Route 128 experienced a loss in population. The residents of the region were moving to communities along the I-495 belt. The areas with the greatest growth included the communities along Route 3 in the South Shore.

By 1990, the City of Boston had actually gained population over the past decade as people started to migrate back to the urban centers. But this shift was small in comparison to the out-migration of the previous four decades. Although some growth occurred in cities located in or near the core, the largest gains were experienced in communities to the south along I-495.

It should be remembered that all of this change in where people lived within the region occurred while the population as a whole remained relatively stable. Unlike other areas of the country like the South and the West that have been experiencing population increases, Boston and New England have not grown in population over the past several decades.

Although MAPC Trends Extended projections show the MPO region as a whole growing by 7% over the next 25 years, there would be little change in the distribution of this population. While the I-495 towns are expected to account for 28% of the population in 2025 (as opposed to 26% in 2000), the urban core would still be the

home of 41% of MPO residents, and the Route 128 region would have 31% of the population. When the remainder of the Eastern Massachusetts model area is included, the MPO's share of the population declines slightly from 71% to 68%. The population of Eastern Massachusetts cities and towns outside of the MPO region is expected to increase 20% by 2025 over current levels. This shift does not include all of the suburbanization that will occur. Even greater proportional population growth than what is being projected for the Eastern Massachusetts model is occurring in southern New Hampshire, central Massachusetts, Cape Cod and the south coast of Massachusetts. What does seem clear is that the 50-year trend of population loss in the urban core has slowed, and that the next 25 years should see a stabilization of the population.

HOUSEHOLDS

The second major change in demographics in the region is the change in the number of households. While the population has remained stable, a dramatic change since 1970 has been the increase in the number of households within the region, an increase of 19% over the two-decade period from 1970 to 1990. The chart of Changes in Demographics in the Boston Region, Figure 3-2, shows the percentage increase from 1970 for employment, households and population. The average number of people per household fell from 3.2 people per household in 1970 to 2.6 people per household in 1990.

There have been several reasons for this trend. One is that an ever-growing number of people have the economic ability to purchase a home and live apart from a larger family unit. Nationally, home ownership is at an historic high, with approximately 67% of all households owning their own home. It should be noted that the home-ownership figure is not as high in the Boston region because of the higher than average cost of living. According to the U.S. Department of Housing and Urban Development, this increase in home ownership has occurred across all income categories.

Another reason for the increase in number of households is that they are no longer as likely to be composed of a “traditional household” of two parents and children. Single-parent households are increasing, as are the number of people living alone. Also, households are not as likely to be composed of more than two generations as they were in the past.

The increased mobility afforded by automobile ownership has allowed people to move farther from work and shopping destinations. Homes and apartments in the less developed or rural areas are usually less expensive and more affordable to more people who otherwise would not have the option of living apart from a larger family unit.

As fewer people live in a household, the demands placed on the transportation system increase. With fewer non-working spouses at home, more automobile trips tend to occur during peak commuting periods. Tasks such as grocery shopping and other errands tend to occur in conjunction with work trips rather than during off-peak hours.

MAPC projections for number of households located in MPO municipalities tell a similar story as the one told through the population projections. The MPO region as a whole experiences an increase of 12% in the total number of households. This outpaces the growth in population described above, and therefore reflects a continuation of the trend toward smaller households. Very small increases in the proportion of households (2%) located in the I-495 region are observed while losses in proportional number of households for the urban core and Route 128 regions are minimal (1%). Again, the number of households located within the model area but outside of the MPO increases slightly, from 28% to 30%.

EMPLOYMENT

While the population has remained constant, the number of jobs within the region has grown dramatically. The Boston region saw a 44% increase in the number of jobs from 1970 to 1990, while experiencing no increase in population. This trend

of job creation continued during the economic expansion of the 1990's.

This increase in employment without an accompanying increase in population has been achieved in several ways, each of which places a greater burden on the transportation network.

- The percentage of residents living within the region who work has increased as more women and teenagers have joined the workforce.
- The number of people holding more than one job has increased
- The number of people commuting from outside the region who work within the region has increased.

All three of these factors place stress on the transportation network during peak travel hours, when the system has the least amount of capacity available to handle the increased demand.

As shown in Figure 3-1, Demographic Shifts for the Boston Region, the percentage of the region's jobs that are located in the urban core has dropped from 54% in 1970 to 47% in 1990. As with population, the shift has been to the outer suburbs. This dispersion of jobs also makes it more difficult to provide transit service for the commuting trips.

Projections out to the year 2025 show MPO job growth at 17%, outpacing both population and household growth. Since the region is currently experiencing very low unemployment, and the majority of women are already in the workforce, this increase in jobs will have to be absorbed by residents from outside the MPO. At the same time, non-MPO Eastern Massachusetts job growth is also projected to grow at 21%. This is comparable to the increase in population projected for those areas, so the increase in MPO jobs will have to be met, in part, by workers commuting from beyond the model area. This further increases the demands on the suburban transportation network to move people efficiently throughout the region.

AUTOMOBILE OWNERSHIP

Automobile ownership has been rising in the region, even in cities like Boston and Cambridge where transit connections are good and walking distances are short. Of the approximately 1.1 million households in the Boston region, 83% own at least one automobile, according to the 1990 U.S. Census. Ownership of an automobile has become a pervasive fact in the 1990s. Of the other 17%, the vast majority are in the communities of Boston, Cambridge, Brookline, Chelsea, Everett, Somerville, Revere, Lynn and Malden in the tra-

ditional urban core. All of these communities have a relatively high level of transit service. As one travels outward from the core, the proportion of households without an automobile decreases.

This widespread ownership of automobiles and high number of households with multiple automobiles are factors in how people determine how to travel. Another factor is the presence or absence of adequate transit service. Regionwide, 45% of all households have at least two automobiles and 12% have three or more.

CONCLUSION

This chapter has attempted to provide a brief overview of the demographics issues facing the region. While the urban core has seen a renaissance of people moving back into the cities over the past decade, the dispersion of people and jobs within the region has continued.

The trends in the four areas this chapter deals with (population, households, employment and automobile ownership) have made it more difficult for the MPO to provide an efficient transportation network to the region's citizens. Instead of a traditional commuting pattern of radial travel to the jobs in the urban core as existed in the 1950s, the region is faced with an ever-increasing pattern of commuting from suburb to suburb.

For a time, the dispersion of people and employment to the suburbs gave relief to urban congestion as people shifted away from a traditional radial commute into the urban core to one of suburban travel. But now that the excess capacity of the highways serving suburb-to-suburb travel is being reduced, the problem of congestion facing the suburbs is growing.

This dispersion of people and jobs also makes it more difficult to use any form of travel other than single occupancy vehicles (SOV). Providing alternative travel options to SOV is more challenging because it becomes harder to find others with the same origin and destination as well as the same travel schedule. The dispersion of people and jobs requires additional costs for all transportation modes. And although population levels across the different regions of the MPO appear to be stabilizing in relation to one another, the increase in commuters from beyond the MPO means that these additional transportation costs will continue to be borne by the MPO agencies and the citizens of the Commonwealth.

But while the Boston MPO faces many of the same challenges in providing transportation options to a diffuse population that other metropolitan areas do, Boston has many strengths to build upon. As one of the oldest metropolitan areas in the country, and one that was mature before the dominance of the automobile, the Boston region has advantages over newer metropolitan areas in the South and West. The vast majority of the development in these newer cities occurred after the popularity of the automobile was well established. The resulting low-density development makes it difficult for them to employ transit as a solution for even traditional suburb-to-downtown commutes. In the Boston region there is a sizable urban core that already supports one of the nation's largest transit system.

The suburbs of Boston are also much different from their "centerless" counterparts in newer metropolitan areas. In the Boston MPO, suburbs are typically anchored by a traditional New England village cen-

ter. The existence of centers that are often accompanied by a transit station in even our suburban regions provides an opportunity for increased density in specific areas throughout the region. The MPO region's age does not make it better suited to deal with the transportation problems faced by many residents in its outlying regions. However, by reinvesting in its historic population and employment core, the MPO can manage transportation challenges by providing its residents and employers with a variety of mobility options.

For a more in-depth discussion of the demographics of housing, employment and its connection with commuting within the Boston region, the reader should refer to *The Demographics of Commuting in Greater Boston*, (CTPS, August 1998). This document has served as a basis for much of the discussion in this chapter. It explains the pattern of commuting seen in the Boston region by looking at demographic trends since 1950. A copy of the document may be obtained by contacting CTPS at 617-973-7100, by faxing a request to 617-973-8855, by downloading from the CTPS web site at www.ctps.org/bostonmpo or by e-mail to transportationplan@ctps.org.

CHAPTER

4

ROADWAY SYSTEM

The region's roadway system is comprised of freeways, expressways, arterials, collector roads, local roads, and bridges. The regional roadway system consists of approximately 23,024 lane miles. Lane mileage within the 101 communities of the MPO region ranges from 41 miles in the Town of Nahant to 2,493 miles in the City of Boston. Funding for roadway improvements (both rehabilitation and new construction) is provided from federal and state resources. Massachusetts annually receives approximately \$510 million per year in federal highway funds, 71% of which is currently allocated by the state and MPO to the Central Artery project and 29% of which is used for the statewide road and bridge program. In addition, the state annually provides funding to match federal-aid, to fund non-federal aid projects, and to address local transportation needs. The legislature generally allocates approximately \$100 million annually in Chapter 90 funds. Chapter 90 money is used by communities to address local transportation needs, subject to criteria established by the legislature and implemented by MassHighway.

ROADWAY CHARACTERISTICS AND PAVEMENT MANAGEMENT

Regionwide, there are 6,726 miles of arterials, including 1,138 miles of interstate; 2,816 miles of collector roads; and 13,932 miles of local roads. Table 4-1 shows the ownership of the lane miles within the Boston MPO region. It is important to note that the classification of a roadway does not necessarily correlate to ownership of the roadway.

Roads and streets are grouped into functional systems according to the types of service they provide.

TABLE 4-1
Ownership of the Regional Highway
System (Lane Miles)

Massachusetts Highway Department	2,494
Metropolitan District Commission	463
Massachusetts Turnpike Authority	202
Massachusetts Port Authority	16
Other State Entities	31
City/Town Accepted	17,909
Federal Agencies	10
Unaccepted (Private)	1,899
TOTAL	23,024

As defined by the Federal Highway Administration (FHWA), freeways, expressways, and arterials provide a high level of mobility at a relatively fast speed for long uninterrupted distances and are not intended to provide access to specific locations. Arterials in the region include all of the interstate highways as well as heavily traveled numbered routes. Examples include Route 2, Route 9, Routes 1 and 1A, and Route 3.

Collector roads provide a lower level of mobility than arterials at lower speeds and for a shorter distance. Collectors connect local roads with arterials and provide access to abutting land uses. Local roads provide a high level of access to abutting land but limited mobility and Figure 4-1 shows a breakdown of roadway ownership, classification, and type.

FIGURE 4-1
Breakdown of Roadway Ownership,
Classification and Type

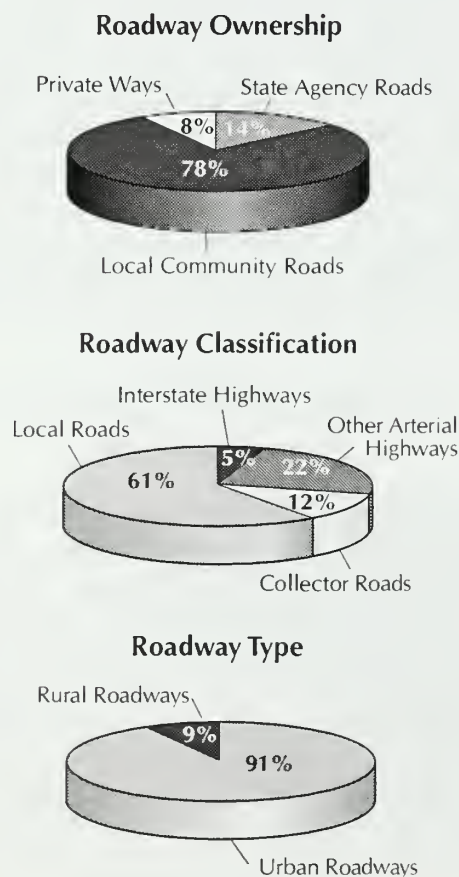
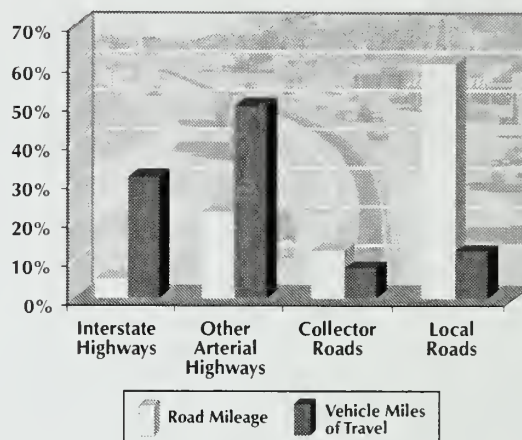


FIGURE 4-2
Roadway Classification and VMT



Over time the nature of a road can change as the nature and character of a community evolves. For example, Route 9 which was constructed as an arterial route connecting the western part of the state to the urban core now also serves a more local function as it traverses community centers and provides access to extensive commercial development. Changes in roadway characteristics often result in operational adjustments: speed limits may be reduced, intersections maybe signalized, and access points may be increased. Nevertheless, the underlying purpose and resulting classification of the roadway does not typically change. While segments of Route 9 may serve a more local purpose, it still remains an arterial highway which provides an important link between regions of the commonwealth.

In response to the evolving characteristics of, and community concerns about, some of the state's roadways and their impacts on the communities through which they traverse, MassHighway has formed a task force to examine how highway projects impact historic and rural areas. The goal of the task force is not to produce new design standards for historic and rural areas, but rather to improve the way in which MassHighway designs, constructs, and reviews projects in these sensitive areas. It is useful to note that MassHighway does have a procedure in place that allows for consideration of design waivers. Communities that would like design waivers are urged to submit requests as early in the design process as possi-

ble. This allows public support to be assessed at, or prior to, the submittal of 25% plans and also can help to contain project costs.

The daily vehicle miles traveled (VMT) by all forms of motor vehicles in the MPO region in 1995 was approximately 62.5 million miles. The vast majority of this travel, approximately 50.2 million miles, occurred on arterial highways, while 4.7 million miles occurred on collector roads and 7.5 million occurred on local roads. Figure 4-2 shows a comparison of regional roadways by classification with the percent of vehicle miles of travel that type of roadway handles. As shown in the figure, arterials carry the majority of daily traffic, while comprising less than 25% of the roadway mileage.

The Massachusetts Highway Department maintains a pavement management system that rates the pavement quality on the Interstate Highway System. Under this system, a pavement serviceability index (PSI) is calculated for each interstate segment encompassing both road roughness and pavement distress. The PSI of a roadway decreases over time due primarily to repeated load applications and environmental factors. A roadway segment with a PSI of 2.5 or less is a candidate for immediate improvement, while those with a PSI of between 2.5 and 3.0 should be considered for rehabilitation in the short term. As of 1998, approximately 5% of the interstate system statewide was in need of immediate attention, while 14% was projected to need rehabilitation in the near future. In the MPO region, approximately 51 center-

line miles of interstate have been identified as candidates for rehabilitation, with approximately 8 miles being rated in poor condition and 43 miles in fair condition.

BRIDGES IN THE MPO REGION

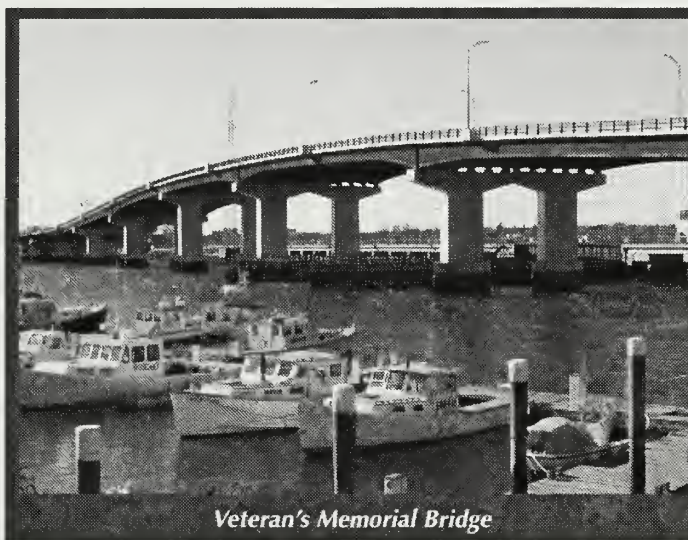
There are 1,516 roadway bridges in the MPO region. The average age of the region's bridges is 39.5 years, while the median date of construction is 1963. The Massachusetts Highway Department maintains a statewide bridge management system. As part of this system, each bridge in the state is periodically inspected and the results of the inspection are tabulated in the Statewide Bridge Inventory.

The bridge inventory rates bridges according to national standards developed by the American Association of State Transportation and Highway Officials (AASHTO). Under the AASHTO standards, bridges are assigned to one of three classifications: meets standards, is functionally obsolete, or is structurally deficient.

A bridge is rated as functionally obsolete if it fails to meet current traffic demands and/or highway design standards. Evaluation criteria include

TABLE 4-2
Classification of Bridges by Owner

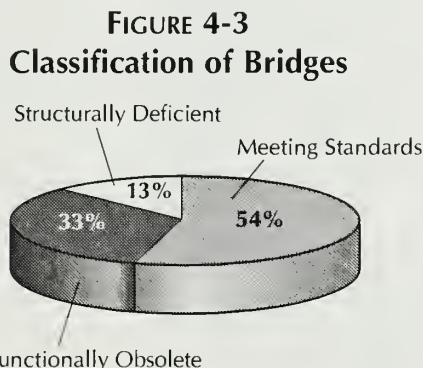
Owner	Total	Meeting Standards	Functionally Obsolete	Structurally Deficient
MassHighway	940	537	295	108
City/Town	255	133	75	47
MassPike	135	84	43	8
MDC	104	45	43	16
MBTA	69	25	28	16
Other State	13	2	11	0
TOTAL	1,516	826	495	195



bridge width, traffic volume and characteristics, and roadway condition. Functional obsolescence is not necessarily caused by a deficiency in the bridge itself, nor is it an immediate safety concern.

A bridge is rated as structurally deficient if it has undergone deterioration significant enough to potentially reduce its load-carrying capacity. Structural deficiency is an indication that reconstruction of the bridge is, or can be expected to be, necessary in the near term.

Table 4-2 shows the AASHTO classification of bridges in the MPO region by ownership and Figure 4-3 shows the overall percentage of bridges within the region assigned to the three AASHTO classifications.



CONGESTION MANAGEMENT

The MPO maintains a congestion management system (CMS) to identify areas with mobility problems and examine alternative solutions to addressing those problems. The impetus for developing and operating a CMS began in 1991 with the federal Intermodal Surface Transportation Efficiency Act (ISTEA). ISTEA required state departments of transportation and metropolitan planning organizations to implement a CMS. ISTEA's successor, the Transportation Equity Act for the 21st Century (TEA-21), adopted in 1998, continues the requirement. CMS findings must be considered in the development of a region's Transportation Plan and its Transportation Improvement Program (TIP). Moreover, for air-quality non-attainment areas such as the Boston region, any expansion of roadway capacity must

be developed in the context of the CMS. Currently, the Boston region is not in attainment for ozone.

The CMS for the Boston Metropolitan Planning Organization (MPO) region is designed to locate mobility problems and demonstrate alternative improvements that can be used by decision makers for project planning, priority setting, and programming. The CMS is a two-part sequential process that consists of the periodic CMS report and CMS planning studies. The purpose of the planning studies is to test and recommend improvements that can eventually be incorporated into Transportation Improvement Program (TIP).

Problems of mobility are identified by three sources: the CMS monitoring program; planning studies; and community comments. The CMS monitoring program identifies problems using performance measures and thresholds of acceptable service. The program is highly systematic in that it covers many facilities and filters out only the most problematic locations.

Planning studies are usually undertaken after some general knowledge of a problem exists. The studies are geared towards exploring problem causes and identifying improvement alternatives. The following list identifies significant planning studies currently underway or completed for the MPO. Studies often constitute the first phase of a project's development, and as such, serve as an indication that the MPO is not only aware of but also is actively investigating a problem.

- Accident Warrants - 3 Sudbury Intersection
- Assabet River Bikeway Feasibility Study
- Bike-to-the-Sea
- Bus Route 66/Arterial Signal Retiming Study
- Central Corridor Bus Service Study
- Central Mass Commuter Rail Feasibility Study
- Central Mass Rail Trail Feasibility Study
- CMS Field Reconnaissance and Monitoring on Arterials

Commuter Rail Service to Bourne
 Commuter Rail Service to I-290 in Northborough
 Commuter Rail Service to Milford
 Commuter Rail Service to Millis
 Congested Signalized Intersections Study - 4 Intersections
 Congested Signalized Intersections Study - 5 Intersections
 Evaluation of the FHWA Bicycle Compatibility Index Using MetroWest Roadways
 Hull Circulation Study
 I-93/I-95 Interchange Improvements, Reading
 Land Use & Transportation Discussion Paper
 Locating New MassHighway Park-and-Ride Lots
 Lower North Shore Transportation Improvement Study
 Lynnfield Square Traffic Operations Study
 MAGIC Subregional Area Study
 Park-and-Ride Lots Phase II: Estimating Demand for MassHighway Park-and-Ride Lots
 MIT Lincoln Lab Employee Relocation Study
 Newton Lower Falls Area Study
 North Shore Bikeway Reconnaissance Study
 North Shore Corridor Bus Study
 Old Colony Impact Study
 Preliminary Feasibility of Saxonville Branch Rail Trail
 Ramp Metering Study
 Route 1 Corridor Bus Study
 Route 1 South Corridor Planning Study
 Route 117 Field Reconnaissance Study
 Route 138 CPS Milton-Canton-Stoughton
 Route 139 Traffic Study, Marshfield-Pembroke

Route 2 Long-Range Corridor Planning Study
 Route 2 Origin-Destination Study
 Route 20 Corridor Study (Weston-Marlborough)
 Route 20 Corridor Study from Boston CBD to Rt 128
 Route 28 Traffic Signal Improvement Study
 Route 3/3A (Cambridge St.) Corridor Study, Burlington-Winchester
 Route 9 Corridor Study in Wellesley
 Route 9 Traffic Study Newton-Brookline
 Route 9/126 Intersection Redesign
 Somerville-Boston Bikeway Reconnaissance Study
 South Corridor Bus Service Study
 Southeast Expressway HOV Lane Before/After Study
 Stoneham Bikeway Reconnaissance Study
 Suburban Public Transportation Study
 Truck Exclusion Mapping Project
 University Avenue/I-93/I-95 Regional Traffic Study

The third source, community comments, is more subjective. Problems expressed through comments stem from people's perceptions and expectations of mobility.

The roadways monitored in the CMS program consist of major arterials and freeways. Over 100 road segments are monitored on a regular basis. Monitoring of roadways is conducted every year, but the roadways included in the program are too numerous to allow monitoring each one every year, so the monitoring is performed in a rotation, each roadway being monitored every three to five years. Each roadway covered by the monitoring program is monitored every three to five years. The program covers roadways that are part of the CMS network. The CMS network consists of all freeways and arterials in the National Highway System (NHS) along with some non-NHS arteri-

als that were added because of their regional significance or in response to comments. Local streets may be monitored on a one-time basis if specific information is needed in a CMS planning activity. Roadway monitoring is conducted September through May during the weekday AM and PM peak commuter periods.

Roadway segments monitored in 1998 and 1999 include freeways, arterials, and local streets. Some of these roadways were selected in accord with the rotational scheduling of CMS monitoring, because they were either not measured or they were under-sampled in previous years. Other roadways were selected because they were identified as problematic in the 1997 Transportation Plan or in comments made by citizen planning groups or individuals. Finally, some roadways were monitored to support CMS planning studies, such as the MetroWest Subregional Area Study and the Bus Route 66 Arterial Signal Retiming Study.

Two performance measures are used to measure congestion on each roadway segment monitored: average travel speed (in mph) and delay (in minutes). The performance measures are calculated from travel time data. Travel time data are collected using a test vehicle that travels with the flow of traffic (the “floating car” technique). The test vehicle is equipped with a global positioning system (GPS) that records travel times and distances at one-second intervals between checkpoints on the system.

The threshold used to define congestion for arterial segments is based on average travel speed and the level-of-service (LOS) concept presented in the 1994 Highway Capacity Manual (HCM). LOS is a qualitative congestion measure based on quantitative data (average travel speed). Six lev-

els of service are defined. They are given letter designations, from A to F, with LOS A representing the best operating conditions and LOS F the worst. LOS E represents capacity conditions. Congestion is defined as LOS E-F. For arterials, the CMS threshold for LOS E-F is 15 mph. For freeway segments in the HCM, LOS is not directly based on average travel speed as it is with arterials, but on other traffic flow measures. Therefore, a threshold unique to the CMS has been defined that closely reflects congestion found on freeway segments in the Boston MPO region. This threshold is 40 mph.

Delay is defined as the condition of a vehicle traveling below 5 mph on a freeway or arterial

segment (including stopped time), as long as the speed has been lower than 5 mph for at least 3 consecutive seconds. This delay is different from “stopped delay” because not only stops, but times during which a vehicle is moving very slowly, are included in the delay calculations.

Speeds and delays are calculated for every roadway segment monitored. Short segments could show low speeds, but minimal delays. Longer segments may have high average speeds, but significant delays. The most congested segments will have both low speeds and high delays. The CMS roadway congestion threshold in terms of delay, for both arterials and freeways, is ≥ 1 minute.

A different approach to identifying problems on arterial roadways is being tested in the SouthWest Advisory Planning Committee (SWAP) subregion. This pilot study introduces new data elements that expand our knowledge about transportation system performance and help to define the CMS planning studies that should be undertaken to improve performance.



Road construction

The CMS's current monitoring program, as explained above, measures the performance of arterial segments using average speed and delay. The SWAP pilot study attempts to identify more precisely the location and cause of congestion problems by shifting the focus from arterial segments to intersections, which is where most congestion problems originate. The new performance measure used to monitor intersections is traffic queue length. Excessive traffic queue length is a good indicator of problems at intersections and of consequent problems on adjacent arterial segments. Data on traffic queue lengths are collected during the AM and PM peak hours, which is when traffic conditions are at their worst.

The pilot study adds a safety component by plotting the locations of vehicle, bicycle, and pedestrian collisions. The addressing of bicycle and pedestrian issues is also pursued through inventorying existing facilities, such as bicycle lanes along roadways and crosswalks at intersections. This information will help prioritize bicycle and pedestrian planning needs.

TRAFFIC SAFETY IN THE REGION

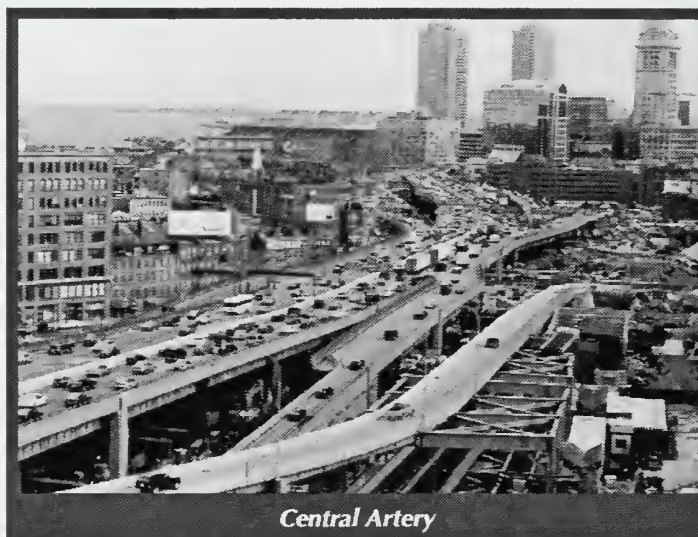
Massachusetts has one of the lowest highway fatality rates in the nation, based on measures of fatalities per licensed driver or fatalities per registered vehicle. In fact, the state highway fatality rate is approximately half of the national rate for these two measures. One of the contributing factors to this record is the effort the state makes to identify and correct high accident locations. The state annually assesses crash data to determine which intersections might be candidates for remedial measures. The Massachusetts Highway Department tracks crash locations as reported in

state police reports, local police reports, and operator's accident reports.

Crash locations are ranked based upon the number and severity of crashes occurring over a given three-year period, with each crash involving a fatality being assigned a weight of ten, each crash involving bodily injury a weight of five, and each crash involving property damage a weight of one.

Map 4-2 (at the end of the chapter) shows the general location of the top crash locations within the MPO region for the years 1994 through 1996. The majority of high-crash locations occur on the major arterial roadways. In addition to loss of life, injury and property damage, crashes also contribute to increased delay that can cause

traffic to be tied up for several hours while the crash is investigated and cleared.



THE CENTRAL ARTERY PROJECT

The Central Artery/Tunnel (CA/T) Project is the largest, most complex roadway project in American history. The project includes a tunnel under Boston Harbor, a 14-lane crossing of the Charles River, an eight-to-ten-lane underground expressway to replace the Central Artery, and the extension of I-90 to Logan Airport.

Planning for the Central Artery/Tunnel Project began in 1982. Congress approved funding and the project's basic scope in 1987. Construction began in 1991 on the Ted Williams Tunnel and a bypass road through South Boston. The first project milestone, the Ted Williams Tunnel under Boston Harbor, opened to traffic in December 1995. The second major milestone, the Leverett Circle Connector Bridge, opened in October 1999.

As of November 1999, final design was about 98 percent complete, construction about 61 percent complete. The I-90 extension via the Ted Williams Tunnel to Logan Airport is expected to open in 2001. The northbound lanes of the underground Central Artery open in 2002, the southbound lanes in 2003. Demolition of the elevated Central Artery then will commence, with the entire project, including restoration of the surface, completed by 2004. With construction scheduled from 1991 to 2004, the region's economic vitality depends on the project allowing the city to continue to operate.

Opened in 1959, the Central Artery comfortably carried about 75,000 vehicles daily. Today it carries upwards of 190,000. The new Central Artery will carry about 245,000 vehicles a day by 2010.

The Ted Williams Tunnel, to be opened to all traffic when the extension is complete, is expected to carry 90,000 vehicles a day, compared to 25,000 a day with traffic restricted to commercial vehicles.

Altogether, the CA/T project is building 161 lane-miles of roadway in a 7.5-mile corridor, about half in tunnels, including four major highway interchanges. The old road has 27 on- and off-ramps; the new one will have just 14. The project will create new parks and open space, including 105 acres at Spectacle Island, 33 acres along the Charles River, and 7 acres as part of an expanded Memorial Stadium Park in East Boston. Three quarters of the 27 acres where the existing elevated highway now stands will remain open.

MAP 4-3
Central Artery Project Status



The deepest point of the underground roadway is 120 feet down, beneath the Red Line subway tunnel at Dewey Square (Atlantic Avenue and Summer Street). The highest point is at State Street, where the roadway passes over the Blue Line subway tunnel and the roof of the highway is the street above.

The underground Central Artery will surface near North Station and cross the Charles River on a 10-lane bridge. The bridge will be the widest cable-stayed bridge in the world, and the first in the United States with an asymmetrical design.

THE METROPOLITAN HIGHWAY SYSTEM

In 1997, the Massachusetts Legislature created the Metropolitan Highway System (MHS) and placed it under the authority of the MassPike. The MHS encompasses the Central Artery, the Central Artery North Area (CANA), the Seaport Access Road, the South Boston Bypass Road, the three harbor tunnels (the Sumner, Callahan, and Ted Williams) and the Massachusetts Turnpike Extension. The MHS does not include the Mystic-Tobin Bridge, operated by Massport.

The MassPike is overseeing the completion of the CA/T project and will be responsible for the day-to-day operation and maintenance of all of the MHS components. The MassPike maintains separate accounts for the MHS and the Western Cost Center (the Route 128 interchange west to New York).

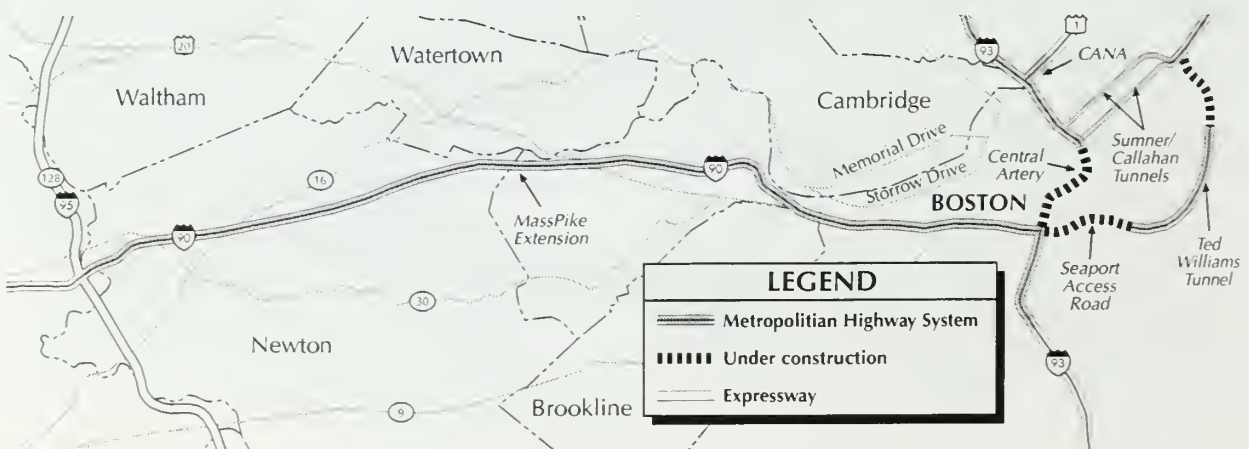
Traffic using the MHS will be monitored by the most advanced traffic management and incident response system in the world, including more than 400 video cameras, 130 electronic message signs, 30 infrared height detectors, and six emergency response stations in operation 24 hours a day.

OTHER CURRENT OR PLANNED HIGHWAY EXPANSIONS

In addition to the Central Artery project, several other capital expansion projects are ongoing or planned for the near future. These projects include, but are not limited to:

- A new interchange on I-93 at the site of the planned Woburn Interdriplex, a regional intermodal transportation facility. The Interdriplex is a cooperative effort of MassHighway, Massport, and the MBTA. When completed, this facility will support commuter rail services, Logan Express shuttles, and a 2,400 space commuter parking lot. The interchange work includes new on and off ramps, bridges, and a connector road to Commerce Way.
- A new interchange on I-495 in Marlborough between Route 9 and Route 20. Major elements of this project include the construction of four new ramps to and from I-495 and Crane Meadow Road. The project was advertised in September 1998.
- The realignment and widening of Route 140 in Franklin. The purpose of this 1.2 mile long project is to widen Route 140 from one lane in each direction to two lanes in each direction from I-495 to Garelick Farms. The alignment of Route 140 will also be altered to accommodate an improved diamond interchange.

MAP 4-4
The Metropolitan Highway System



- The addition of travel lanes on Route 128 between Randolph and Wellesley. This 13.7 mile long project involves the addition of one travel lane in each direction to increase capacity on a segment of Route 128/I-95. Other towns within the project limits are Canton, Westwood, Dedham and Needham. The project also includes modifications to bridges and the redesign of the Highland Avenue interchange in Needham. The early design phases are active. The project is still under environmental review with MEPA.
- The addition of travel lanes on Route 3 from Burlington to the New Hampshire border



MEASURES TO INCREASE AUTOMOBILE OCCUPANCIES AND EFFICIENCIES

The member agencies of the Boston MPO have taken numerous measures to provide alternative driving options. Measures that increase vehicle occupancy, help in relieving congestion, or allow for a more efficient use of the roadway network fall under the broad categories of Transportation Demand Management (TDM) and Intelligent Transportation Systems (ITS). TDM measures involve a wide range of strategies such as promoting ride-sharing, allowing for flextime or alternate work schedules, traffic calming measures or subsidizing the cost of non-SOV travel.

Congestion can be reduced not only by removing vehicles, but by getting them through toll booths more efficiently, and by letting drivers know of congestion ahead so they can plan alternative routes or times for travel. Congestion is not only a nuisance for those in it, but also an expense for

businesses and employers, and a source of pollution.

The average round-trip commuting distance for all commuters in Massachusetts is 26 miles. In 1988, it cost drive-alone commuters \$2,427 a year to travel this distance. Based on 1997 statistics, drive-alone commuters making a 26-mile daily

round trip pay \$4,029 annually - an increase of 66%.

For commuters with longer work trips, the cost increases have been more dramatic. For example, the cost of driving alone, 50 miles each way, jumped from \$4,816 in 1988 to \$7,306 in 1997 - an increase of \$2,490. Commuting 100 round-trip miles a day in a two-person

carpool can cut this cost in half. In addition, the cost of commuting in a 14-passenger vanpool, 50 miles each way, was only \$1,215 a year in 1997 - an increase of only \$311 since 1988.

CARAVAN

As Massachusetts' statewide commuter services organization, CARAVAN provides assistance to commuters, companies, and Transportation Management Associations (TMA) throughout the Commonwealth. A private, nonprofit organization, CARAVAN receives funding from the Massachusetts Highway Department and the Federal Highway Administration.

CARAVAN's 1-888-4-COMMUTE toll-free information line phone number and the "Commuter Information Center" (www.commute.com) provide information from over 50 public and private transportation providers statewide. CARAVAN also operates RideSource, an enhanced commute management system. Callers who become subscribers in the computerized ride-

matching system receive a customized report containing, on average, 15 transportation alternatives to driving alone. These options include rail, bus, boat, carpool, and vanpool.

The CARAVAN Vanpool consists of approximately 200 vehicles, with origins all over Massachusetts and Southern New Hampshire. CARAVAN's RideGuide, updated monthly, lists the seats available on commuter vanpools.

CARAVAN administers the statewide Transportation Management Association (TMA) Assistance Program. TMAs are private, nonprofit groups formed by businesses to facilitate private sector involvement in addressing transportation issues. TMAs encourage transit, shared-ride commuting, and variable work hours to reduce traffic congestion. Some TMAs operate shuttle services among work sites or connecting to transit stops.

CARAVAN analyzes worksite commuter transportation patterns and needs and makes recommendations for transportation demand management (TDM) programs. Programs include parking management strategies, alternative work hour programs, on-site transit pass sales and subsidies, Commuter Choice tax benefits, Commuter Checks, Guaranteed Ride Home services, and the formation of shuttles to transit.

CARPOOLS

According to 1990 U.S. Census data, 12.8% of commuters across the country go to work in a carpool containing 2 or more people. In Massachusetts, 10.8% of commuters travel in 2-to-5 person carpools.

Carpoolers heading to Boston from the north and south can use the High Occupancy Vehicle (HOV) lanes on Route 93 North (for two miles, from Mystic Avenue in Medford to the Route 1/93 merge) and on Route 3 South (for six miles, from Furnace Brook Parkway in Quincy to Freeport Street in Boston). Operated by MassHighway, the lanes are open during the peak morning and evening commuting hours. Many worksites provide preferential parking for carpools, often located near main building entrances.

In addition, commuter groups of three or more can register for the FAST LANE program as a carpool. They pay an annual carpool fee based on the MassPike zone(s) that they travel, which is a considerable discount. To date there are over 1,500 registered carpools in MassPike's program.

VANPOOLS

Vanpooling is a cooperative agreement in which 7 to 15 commuters with common schedules share the ride to work. There are cost savings, and other benefits provided to vanpoolers. Massachusetts offers free registration and license plates to all qualified vanpools. Like MBTA commuters, vanpool passengers are eligible to receive a discount on their personal automobile insurance.

In cooperation with the Central Artery/Ted Williams Tunnel Project, the MassPike, the Massachusetts Highway Department, the MBTA, the City of Boston, the MDC, and private property managers, CARAVAN has secured over 100 free and discounted parking spaces. The Boston Transportation Department has designated Vanpool Boarding Zones conveniently located on major commuting routes throughout the city.

ITS

Intelligent Transportation Systems (ITS) involves the integration of the latest in computers, electronics, communications and safety systems. The Boston MPO has participated in the development of Intelligent Transportation Systems (then Intelligent Vehicle Highway Systems) activities in Eastern Massachusetts and the state since 1992. Boston was one of the first cities to complete an FHWA-sponsored metropolitan area deployment plan for ITS, in 1993. The two-phased plan extends to the year 2000.

A new Regional Traffic Operation Center (RTOC) is being constructed in South Boston. This operation center will include eight stations that will assist patrol officers in incident management and detection. Other responsibilities include daily data collection and surveillance. Also implemented is

a Motorist Assistance Program that will provide roadside assistance to motorists.

The Central Artery project is incorporating ITS and other advanced technologies into its design, including intensive infrastructure for vehicle detection and surveillance, automatic incident detection, and emissions monitoring.

The I-93 Integrated Transportation Management System Operational Test will cover a 4-mile segment of I-93 immediately north of downtown Boston, including the HOV lane, parallel arterials and the Orange Line. The project will gather real time data on these transportation links, simulate these data and forecast travel time 5-10 minutes into the future on each link. This information will be conveyed to motorists via variable message signs and eventually via in-vehicle devices.

In addition, the Boston MPO has contributed to and supported the activities discussed below.

INCIDENT MANAGEMENT

Boston MPO staff supported the State's Traffic Management Team with technical analysis and administrative services on the following programs: *SP program, including the development of Public Service Announcement for the program; Motorists Assistance program; and the development of an Operations Manual for Incident Management.

IVHS STRATEGIC DEPLOYMENT PLAN FOR METROPOLITAN BOSTON

During the development of the plan, Boston MPO staff served on the technical committee overseeing the project. The plan recommended an Intelligent Vehicle Highway Systems (IVHS) Architecture and the following priority functions:

- Incident Management
- Trip Planning
- Demand Management
- Electronic Toll Collection
- Traveler Information

- Route/Mode Guidance
- Construction Management

TECHNICAL SUPPORT IN MASSHIGHWAY'S CONSULTANT SELECTION COMMITTEES

At the request of MassHighway, the Boston MPO staff participated in the evaluation of consultant teams who were hired to execute recommendations from the Early Deployment Plan. Examples include the programs on Motorists Assistance and Advanced Traveler Information Services.

ITS PROGRAM EVALUATIONS

The Boston MPO performed evaluations of benefits, including delay and air quality reductions, resulting from the application of ITS programs such as Samaritania and the *SP program. Other activities supported by the MPO and its staff include:

- Feasibility of Ramp Metering for Selected Highways: Modeling and other screening tools were used to test the feasibility of installing ramp meters at on-ramps along I-95/Route 128 and selected other locations.
- I-93 Integrated Traffic Management System Operational Test: I-93 and arterial roads in Somerville, Medford and Boston were modeled to simulate incident management strategies for incidents at various segments along the highway.
- HOV Analysis and Monitoring: As part of the Route 128 Transportation Improvement Project, the regional impacts from various HOV, Incident Management, and Transportation Demand Management scenarios were modeled.
- MBTA "B" Green Line Signal Priority Strategies: As part of the Route 20 Corridor Planning Study, the MPO staff evaluated several scenarios pertaining to signal priority along Commonwealth Avenue for the Green Line.
- Traffic Signal Coordination Projects: As part

of its corridor planning studies, the MPO routinely uses signal coordination, an ITS strategy, to test operational improvement along arterials.

- ITS Massachusetts and ITS America: MPO staff have been active members of the Technical and Publications Committees of ITS Massachusetts.

SMARTTRAVELER®

In 1992, SmartRoute Systems, in partnership with MassHighway, began operation of the SmarTraveler® Operational Test in Boston, funded by the FHWA Office of Intelligent Transportation Systems and Traffic Operations. SmarTraveler® delivers real-time, on-demand, location-specific traffic and transit information to users with a touch-tone phone, free of charge (617-374-1234 or * 1 on cellular). Traveler information is also disseminated through on-line services, television, radio, and print media. The SmarTraveler® service has been evaluated by MassHighway and has proven highly effective at modifying traveler behavior, and is being incorporated into long-term congestion management plans.

The service area in Eastern Massachusetts covers approximately 1,400 square miles, encompassing 122 communities, an estimated 2.9 million licensed drivers, and 2.8 million registered vehicles. Eighteen separate roadways or roadway segments totaling 701 miles and carrying 1.7 million vehicles daily are covered. The service also includes the MBTA's commuter rail, bus and subway systems.

The SmarTraveler traffic and transit surveillance consists of cameras at strategic locations around

greater Boston; "mobile probes" reporting to the operations center by mobile phone or two-way radio; monitoring of 350 publicly available radio frequencies for emergency vehicles, and direct lines to the State Police, Amtrak, MassHighway, and the MBTA.

SmartRoute Systems operates the Interim Operations Center (IOC) for Boston's Central Artery/Third Harbor Tunnel project. Project responsibilities include collecting and communicating data to a variety of target audiences, including the general traveling public, the media, and project personnel. The IOC is a 24-hour-a-day, 7-day-a-week operation that has been operating since 1995.

FAST LANE

FAST LANE is an electronic toll collection system instituted in phases along the Massachusetts Turnpike beginning in October 1998. Vehicles in the FAST LANE system are equipped with a transponder mounted to the windshield behind the rear view mirror. The transponder signals that a vehicle is going through a designated toll plaza. The cost of the toll is then automatically deducted from or charged to a pre-established account. Registered vehicles with FAST LANE transponders can then pass through toll booths without stopping or waiting.

FAST LANE is in operation statewide on the Massachusetts Turnpike, at the Ted Williams Tunnel, the Sumner / Callahan Tunnels, the Tobin Bridge, and is interoperable with EZPass, the electronic toll system used in New York, New Jersey and Delaware.

CONCLUSION

The regional roadway infrastructure, while in fairly good condition, is relatively mature. As such, one of the major challenges in the transportation plan process is determining the appropriate level of funding to reserve for system rehabilitation and reconstruction, while also providing sufficient capital to judiciously expand the existing roadway system or maximize system usage. As with most transportation plan issues, an underlying concern affecting the MPO's decision-making process will be the interaction between transportation funding decisions and local land-use and regional economic development.

Additionally, it is important for the MPO to focus on measures to improve the efficiency of the existing system through transportation demand management measures and ITS, and to ensure that the character and historical quality of the communities of the region is preserved.

Accordingly, issues that are addressed in subsequent chapters of this plan include:

- Identifying the appropriate level of investment in the current system, sufficient to maintain and improve the region's existing roadways and bridges.
- Selecting capital expansion projects to improve mobility where needed and prudent.
- Promoting strategies for alternatives to single-occupancy travel and taking advantage of technology to improve the efficiency of the roadway system
- Analyzing the impact of transportation decisions on land-use and regional economic development.

● Crash locations

Table 4-3
CRASH LOCATIONS

City or Town	Intersecting Streets	City or Town	Intersecting Streets
Bellingham	Hartford Avenue & I-495	Medford	Mystic Valley Pkwy & I-93
Boston	Leverett Circle	Medford	Roosevelt Circle
Boston	I-93 & Beach Street	Medford	I-93 & Salem Street
Boston	Columbia Road & I-93	Milton	Granite Avenue & I-93
Boston	Charlesgate West & Storrow Drive	Natick	Route 27 & Route 9
Boston	Mass Ave & Melnea Cass Blvd	Natick	Hartford Street & Speen Street
Boston	City Square & Rutherford Avenue	Natick	Oak Street & Route 9
Boston	Brookline Avenue & the Riverway	Needham	Highland Avenue & Route 128
Boston	Callahan Tunnel & I-93	Newton	Centre Street & Mass Pike
Boston	Charles Circle & Cambridge Street	Newton	Grove Street & Route 128
Boston	Blue Hill Avenue & Talbot Avenue	Peabody	Lowell Street & Route 1
Boston	American Legion Hwy & Blue Hill	Peabody	Route 114 & Route 128
Boston	Blue Hill Avenue & Morton Street	Peabody	Route 1 & Route 128
Boston	Comm Ave & Harvard Ave	Quincy	Rotary Circle & I-93
Boston	Soldiers Field Rd & Western Ave	Randolph	Route 128 & Route 24
Boston	Cambridge Street & Mass Pike	Randolph	Route 28 & Route 128
Boston	Morton Street & Norfolk Street	Revere	Bell Circle
Boston	Freeport Street & Victory Road	Revere	Copeland Circle
Braintree	Granite Street & Route 128	Revere	Broadway & Route 60
Burlington	Route 3 & Route 128	Saugus	Route 1 & Walnut Street
Burlington	Cambridge Street & Route 128	Saugus	Main Street & Route 1
Cambridge	Mass. Ave & Memorial Dr	Saugus	Essex Street & Route 1
Canton	I-95 & I-93	Somerville	McGrath Highway & Mystic Ave
Chelsea	Garfield Av & Revere Beach Pkwy	Somerville	Broadway & McGrath Highway
Concord	Route 2 & Route 2A Rotary	Somerville	McGrath Hwy & Washington St
Danvers	Route 1 & Route 114	Stoneham	Main Street & Route 28
Danvers	Endicott Street & Route 128	Waltham	Winter Street & Wyman Street
Everett	Route 16 & Route 99	Waltham	Route 128 & Route 20
Everett	Route 16 & Santilli Highway	Wellesley	Route 128 & Route 9
Framingham	Route 30 & Route 9	Wellesley	Grantland Road & Route 9
Framingham	Edgell Road & Route 9	Westwood	East Street Rotary & Route 128
Framingham	Route 126 & Route 9	Wilmington	I-93 & Route 129
Framingham	Hollis Street & Route 9	Woburn	I-93 & Route 128
Gloucester	Route 128 & Blackburn Circle	Woburn	Alfred Street & Main Street
Marlborough	I-495 & I-290	Woburn	Montvale Avenue & I-93
Medford	Route 16 & the Fellsway	Woburn	Route 128 & Washington Street



CHAPTER 5

TRANSIT SYSTEM

The region's public transportation network plays a vital role in providing mobility for residents and visitors who prefer not to drive or are unable to drive, sustaining a high quality of life and environment, and fueling the regional economic growth. The Boston metropolitan area is served by a hub-and-spoke network of rapid transit, streetcar, express bus, commuter rail and commuter boat lines. Where available, these services provide high quality and cost-effective commuting alternatives to the single-occupant automobile. Local bus and trackless trolley services fill in the gaps between spokes by offering line-haul service in heavily congested areas, feeder services to rail, and inter-suburban linkages throughout the region. Demand-response transportation for people with disabilities and the elderly, is also provided.

THE EXISTING PUBLIC TRANSIT SYSTEM

The Massachusetts Bay Transportation Authority (MBTA) is the primary transit provider in the region. The MBTA directly operates or contracts out for service using seven different modes: heavy rail, streetcar, local/express bus, trackless trolley, commuter rail, commuter boat and paratransit. While the commuter rail network extends beyond the MPO region to the far reaches of the MBTA's 188 community district, local MBTA bus service is limited to an area extending from Boston to just beyond Route 128. Rapid transit and streetcar service is limited to the inner core communities. Local bus service in the Gloucester/Rockport area is provided by the Cape Ann Transportation Authority (CATA).

Rapid Transit and Streetcar

The MBTA rapid transit and streetcar systems serve 125 stations on five lines: The Red Line, Orange Line, Blue Line, Green Line and Mattapan High Speed Line. Daily ridership on the rapid transit/streetcar system is approximately 663,000 trips per weekday. All the ridership data reported in this chapter is a composite average for FY 2000 and reported as unlinked trips. The source for all of the data in this

chapter is either the MBTA or CTPS as part of the MBTA's ongoing data collection effort. The data for maximum load capacity for fleet vehicles includes passengers seated and standing.

Red Line

Of the three rapid transit lines, the Red Line is the longest at 21 miles, and the most heavily utilized, generating an average 218,000 trips per weekday. There are 22 stations on the Red Line, 17 of which are accessible. Service runs on two branches, between Alewife Station in North Cambridge and Ashmont Station in Dorchester or Braintree Station in Braintree. Communities

directly served are Cambridge, Somerville, Boston, Quincy, and Braintree. All service operates along a common alignment between Alewife and the JFK/UMass Station in Dorchester, at which point service branches off to either Ashmont or Braintree. Throughout most of the day, service is split equally between the two branches. The MBTA runs 6-car trains during the a.m. and p.m. peak hours and 4-car trains at other times. There are 218 cars in the Red Line fleet. The fleet consists of 74 cars built in 1969, 58 cars built in 1987-88, and 86 cars built in 1994. During the peak hour, 170 passengers per car is considered maximum load. Park-and-ride facilities provide over 11,000 parking spaces. Rush hour trains

MAP 5-1
MBTA System

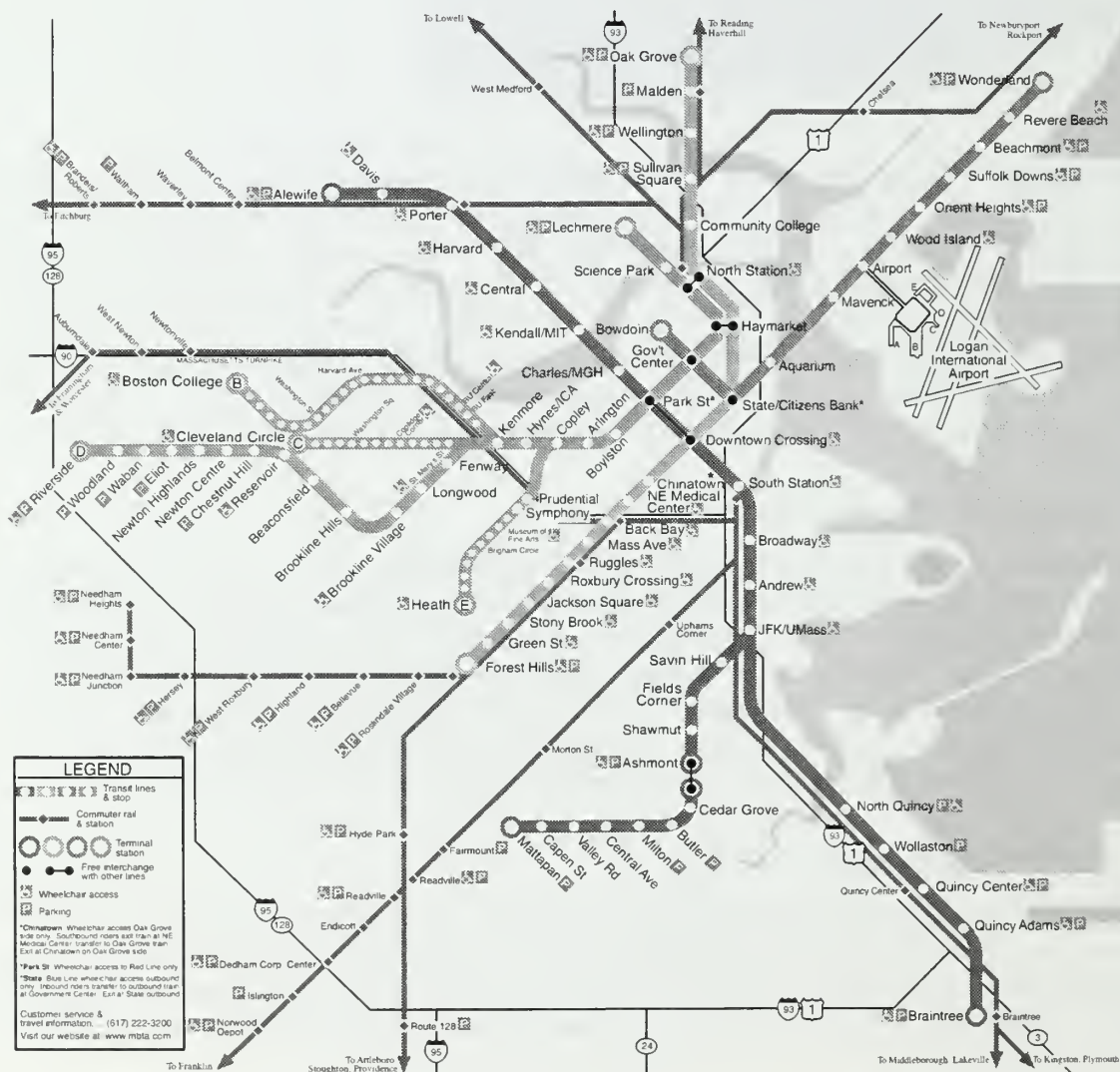


TABLE 5-1
MBTA Vehicle Fleet by Year Built

Quantity/Type of Vehicles	Year Built
Diesel Bus	
198	1985
180	1986
200	1989
137	1994
261	1995
Alternative Fuel Bus	
4	1999
Trackless Trolley	
40	1976
Green Line	
55	1976-78
95	1986-87
20	1997
100	1999-2001 (Delivery underway)
Mattapan-Ashmont	
11	1945 (rebuilding program underway)
Red Line	
74	1969 (rebuilt 1985-88)
58	1987-88
86	1994
Orange Line	
120	1980-81
Blue Line	
70	1979-80
Commuter Rail Coaches	
57	1979 (rebuilt 1996)
40	1987
67	1987-88
107	1989-90
75 (bilevel)	1990-91
17 (bilevel)	1997
15 (bilevel)	on order for 2001
Commuter Rail Locomotives	
13	1978
5	1980
25	1987-88
9	1991
3	1993
25	1997 (remanufactured)

operate at 8 minute intervals from Braintree and Ashmont and at 4 minute intervals between JFK/UMass and Alewife. Average speeds on the Braintree and Ashmont branches are 23.3 mph and 19.2 mph respectively. Peak hour capacity totals 12,200 passenger trips.

Mattapan High Speed Line

The Mattapan High Speed Line connects with the Red Line and operates between Ashmont and Mattapan through the Dorchester neighborhood of Boston and the town of Milton. Service is provided by 11 PCC streetcar vehicles built in 1945-46. A program is underway to rebuild this equipment and extend its service life by another 15 years. The line can be considered an extension of the Red Line in most respects, but its vehicles are maintained and operated as part of the Green Line

fleet. The Mattapan High Speed Line vehicles run as single cars. The line, 2.7 miles long, has eight stations, close to 300 parking spaces and generates 7,000 passenger trips per weekday.

Orange Line

The Orange Line is 11 miles long and operates between Oak Grove on the Malden/Melrose line and Forest Hills in Jamaica Plain serving the communities of Malden, Medford, and Boston. 15 of its 19 stations are accessible (work is in progress at Chinatown-southbound and North Station), and 165,000 trips are generated each day. The Orange Line fleet consists of 120 vehicles built in 1979-81. During the peak hour, 130 passengers per car is considered maximum load. Park-and-ride facilities provide over 5,400 spaces. The MBTA runs 6-car trains during weekday

TABLE 5-2
Characteristics of the Rapid Transit System

	Fleet Size (# Cars)	Trains	(# Cars/ Train)	Req'mt (# cars)	Headway (Minutes)
RED LINE	218	27	6	162	4
Ashmont		11	6	66	8
Braintree		16	6	96	8
MATTAPAN	11	6	1	6	4
ORANGE LINE	120	17	6	102	5
BLUE LINE	70	14	4	56	3.5
GREEN LINE	170	74	2	148	1.3
Boston College		22	2	44	4.5
Cleveland Circle		13	2	26	6.5
Riverside		26	2	52	4.5
Heath Street		10	2	20	9
Run-as-Directed		3	2	6	

Note: 1.3 minute Green Line headway is between Government Center and Copley, and 4 minute Red Line headway is between Alewife and JFK/UMass.



peak and midday hours and 4-car trains at all other times. Rush hour trains operate at 5 minute intervals at an average speed of 20.2 mph. Peak hour capacity is approximately 10,140 passenger trips. The MBTA plans to improve the signal system between Haymarket and Oak Grove to match the signal capabilities already in place on the remainder of the line. The MBTA also plans to increase the Orange Line fleet by between 18 and 24 cars. This equipment will either be new cars or rebuilt former Blue Line cars.

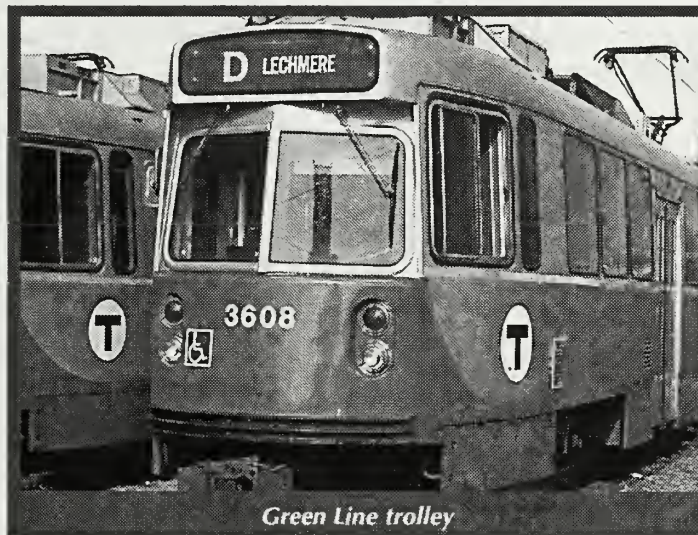
Blue Line

The six mile long Blue Line is the shortest of the three heavy rail lines and operates between Wonderland Station in Revere and Bowdoin Station in the Government Center area of Boston. Twelve stations, seven of which are accessible (work is ongoing at Aquarium and Airport), generate 57,600 weekday trips. The Blue Line fleet consists of 70 vehicles built in 1978-80 and 95 passengers per car is considered the maximum load. Park-and-ride facilities provide over 3,900 spaces. Rush hour trains operate at 3.5 minute intervals at an average speed of 18.7 mph. All trains are 4 cars in length at all times. Peak hour capacity totals 6,460 passenger trips. The MBTA plans to eventually operate 6 car trains on the Blue Line, and is in the process of procuring a new fleet of 94 vehicles for Blue Line service.

Green Line

The Green Line, which uses light rail vehicles (LRVs), generates approximately 215,000 trips per weekday over 23 miles of track in Cambridge, Boston, Brookline, and Newton. The line is composed of 70 stations, 13 of which are

underground or elevated in the Central and Huntington Avenue subways. 13 other stations are on the surface rapid transit Highland branch (D-branch) of the Green Line. The remaining 44 stations are surface stops on three streetcar branches to the west and southwest of downtown Boston: the Boston College branch (B Line) with 22 stops, the Cleveland Circle branch (C Line) with 13 stops, and the Heath St. branch (E Line) with 9 stops. 13 of the 70 Green Line stations are accessible. The northern terminus of the Green Line is at Lechmere Station in Cambridge; Heath Street and Riverside trains operate that far. Because ridership north of downtown Boston is much lower than to the west and southwest, Boston College and Cleveland Circle trains turn around at Government Center. There are 170



Green Line trolley

LRVs in the Green Line fleet (with an expansion to a 215 car fleet by 2002). The Green Line streetcar vehicle fleet consists of 55 cars built in 1976-78, 95 built in 1986-87, and 20 built in 1997. Delivery of 100 low-floor cars began in 1999 and should continue to 2002. These cars will replace the 55

cars built in 1976-77. 110 passengers per car is considered maximum load. Park-and-ride facilities provide over 1,900 spaces. Rush hour trains operate at 5 to 8 minute intervals on the four branches and at 1.3 minute intervals between Copley and Government Center stations. Peak hour capacity totals 9,020 passenger trips.

BUS AND TRACKLESS TROLLEY

The MBTA operates approximately 170 bus routes throughout the MBTA district serving the following 44 municipalities:

Arlington, Bedford, Belmont, Beverly,

Boston, Braintree, Brookline, Burlington, Cambridge, Chelsea, Danvers, Dedham, Everett, Hingham, Holbrook, Lexington, Lynn, Malden, Marblehead, Medford, Melrose, Milton, Nahant, Needham, Newton, Norwood, Peabody, Quincy, Randolph, Reading, Revere, Salem, Saugus, Somerville, Stoneham, Swampscott, Wakefield, Walpole, Waltham, Watertown, Westwood, Weymouth, Winchester, and Woburn

Four electric trackless-trolley lines also operate in Cambridge, Watertown and Belmont.

In FY 2000, total bus and trackless trolley ridership was approximately 376,000 trips per week-day.

Nearly all routes connect with the rapid transit system. In areas close to the Boston urban core, bus service provides crosstown service, feeder service to rapid transit stations, and line haul service in heavily congested areas. Further out, buses provide local service and feeder service to rapid transit and some commuter rail lines. The MBTA bus fleet consists of 378 diesel buses built in 1985-87, 200 diesel buses built in 1989, 398 diesel buses built in 1994-95, and 4 alternative-fuel vehicles built in 1999. The fleet also includes 40 electric trackless trolleys built in 1976. The MBTA is in the process of procuring additional alternative fuel buses including CNG buses, dual-mode vehicles for the South Boston Transitway and new trackless trolleys to replace the present fleet.

MAP 5-2
Commuter Rail System



The MBTA operates express bus routes service to Boston from 11 communities: Newton, Watertown, Waltham, Medford, Burlington, Woburn, Lynn, Marblehead, Nahant, Salem, Saugus, Swampscott, and the Boston neighborhood of Brighton.

Buses serve over 8,500 stops, approximately 360 of which are equipped with bus shelters. Park-and-ride lots for bus service have over 400 parking spaces. The present MBTA bus network consists mostly of routes taken over from the Metropolitan Transit Authority (MTA) in 1964 and several previous private operators. Most of these routes have lengthy histories, and many had their origins as streetcar lines built before 1900. Schedules and route alignments have been revised gradually over the years, but most continue to operate along the same general alignments in response to continuing demand.

The MBTA is presently building the Silver Line, a Bus Rapid Transit (BRT) system serving several corridors. On Washington St., between Dudley Sq. and Downtown Crossing, the Silver Line will consist of a busway featuring bus priority lanes, shelters, real-time schedule information, electronic signage, a public address system, and an intercom assistance system. Between South Station and the World Trade Center, the Silver Line will make use of an underground transitway with stops at South Station, the Federal Courthouse, and World Trade Center. The dual-mode vehicles will then continue on the surface, providing direct service to the new Boston Convention Center, the Boston Marine Industrial Park, and to Logan Airport. These Washington St. and South Boston segments will be connected by a new underground tunnel between New England Medical Center and South Station with stops at Boylston St. (Green Line connection) and Chinatown (Orange Line connection). Service on Washington St. is projected to start in 2001, service from South Station to the World Trade Center in 2003, and between New England Medical Center and South Station in 2008.

COMMUTER RAIL

The 265-mile commuter rail network is comprised of 13 radial lines, with 119 stations (73 of which are accessible). In FY 2000, weekday ridership was over 127,000. The commuter rail system is split into two sides. Northside service operates to and from North Station, and southside service to and from South Station. The Mass. Turnpike can be considered the dividing line between North and South Station service: all routes north of the Turnpike—the Rockport, Newburyport, Haverhill, Lowell, and Fitchburg lines operate to and from North Station. Lines along the Mass. Turnpike or to the south—the Framingham, Needham, Franklin, Attleboro/Providence, Stoughton, Fairmount, Middleborough, and Kingston/Plymouth lines – operate to and from South Station. All southside lines except the Fairmount Line, Middleborough Line, and Kingston/Plymouth Line also serve Back Bay Station.

The 72 municipalities served directly by commuter rail are:

Abington, Acton, Andover, Attleboro, Ayer, Belmont, Beverly, Billerica, Boston, Braintree, Bridgewater, Brockton, Cambridge, Canton, Chelsea, Concord, Dedham, Fitchburg, Framingham, Franklin, Gloucester, Grafton, Halifax, Hamilton, Hanson, Haverhill, Holbrook, Ipswich, Kingston, Lakeville, Lawrence, Leominster, Lincoln, Littleton, Lowell, Lynn, Malden, Manchester, Mansfield, Medford, Melrose, Middleborough, Natick, Needham, Newburyport, Newton, Norfolk, Norwood, Plymouth, Providence RI, Quincy, Randolph, Reading, Rockport, Rowley, Salem, Sharon, Shirley, Stoughton, Swampscott, Wakefield, Walpole, Waltham, Wellesley, Wenham, Weston, Westwood, Weymouth, Whitman, Wilmington, Winchester, Woburn, and Worcester.

New stations are under construction or planned on the Worcester line at Ashland, Southborough, and Westborough. New commuter rail lines planned include the Greenbush line which will

serve Weymouth, Hingham, Cohasset, and Scituate, and the New Bedford/Fall River service which will include stations in Easton, Raynham, Taunton, Freetown, Fall River, and New Bedford. The states of Rhode Island and New Hampshire are also considering the expansion of the network, with Rhode Island developing an extension of the Providence line to T. F Green airport and New Hampshire considering the extension of the Lowell line to Nashua NH and the Haverhill line to Plaistow NH.

The commuter rail passenger coach fleet consists of 363 vehicles: 57 single-level coaches built in 1979 and rebuilt in 1996, 214 single-level coaches built in 1987-90, 75 double-deck coaches built in 1990-91, and 17 double-deck coaches built in 1997. An additional 15 double-deck coaches are on order for delivery in 2001. Double-deck coaches have seating capacities of 182 vs. 127 for a single-level car.

The commuter rail locomotive fleet consists of 83 units: 18 units built in 1978-80, 25 units built in 1987-88, 12 units built in 1991-93, and 25 remanufactured units delivered in 1997-99. The fleet also includes 3 work locomotives built in the 1950s which are used for non-revenue duties.

A total of 453 weekday inbound and outbound trips are scheduled, with headways ranging from 25 to 40 minutes during peak periods, and from one to four hours during off-peak times. Over 30,000 park-and-ride spaces are provided, or under construction, for commuter rail riders.

COMMUTER BOAT

- MBTA commuter boat service is operated by two contractors and operates between: Hing-

ham and Rowes Wharf (Boston)

- Point Pemberton in Hull and Long Wharf (Boston)
- the Charlestown Navy Yard and Long Wharf
- the Charlestown Navy Yard and Lovejoy Wharf (Boston)
- Lovejoy Wharf to World Trade Center via the Federal Courthouse (Boston).

A total of 1,815 parking spaces are provided in Hingham and Hull. The total annual ridership in Fiscal Year 1999 was 1.2 million passengers.

KEY STATIONS PROGRAM

The Americans with Disabilities Act (ADA), which was passed by the federal government in 1990, mandated improvements to a wide variety

of facilities and infrastructure throughout the country to ensure that they are accessible. This created particular challenges for the MBTA, whose subway system is the oldest in the nation. The age of the system, combined with the fact that more than half of the MBTA's metro and light-rail stations are streetcar stops,

resulted in the Federal Transit Administration approving the MBTA's Key Station Program. This program designates 80 stations in the MBTA system that must be brought into compliance with ADA.

The Key Stations consist of several commuter rail and heavy rail stations that were not previously compliant, most Green Line subway stops, and several important Green Line surface stops. Currently, 51 of these 80 stations are compliant, and 27 more are in design or construction stages. Any new stations, such as those on recent commuter



rail extensions to Worcester, Newburyport, Middleborough and Plymouth, must be built in compliance with ADA although they are not included in the Key Station Program. Recently modernized Blue Line Stations not included in the program were also brought into compliance.

In the first couple of years of the program, the MBTA succeeded in bringing all but seven commuter rail Key Stations into compliance. Compliance has since been achieved at Bradford, Fitchburg, and Route 128 stations. Work is presently underway at Framingham and Canton Junction Stations. Work remains to be done at Fairmount station and Malden station.

The majority of work that remains in the Key Station program is on the Green Line's downtown subway and Green Line surface routes. Surface stations in the program are those at the transfer points between the Green Line and major bus routes (Coolidge Corner, Harvard Avenue, Brookline Village, etc.) and those that serve large academic and medical institutions (BU Central, BU East, Brigham Circle, etc.). All transfer points between the Blue, Red, Orange, Green and commuter rail lines are also in the program. Underground and elevated Green Line stations included in the Key Station plan are Lechmere, North Station, Haymarket, Government Center, Park St., Arlington, Copley, and Kenmore. Stations on the Highland Branch include Fenway, Brookline Village, Reservoir, Newton Centre, and Riverside. Surface streetcar stops on the B, C, and E lines include: BU East, BU Central, Harvard Ave., Washington St., Boston College, St. Mary's St., Coolidge Corner, Washington Sq., Cleveland Circle, Northeastern, Museum Fine Arts, Longwood Medical, Brigham Circle, and Heath St./ VA Med. Temporary access has been achieved at 13 sta-

tions including Park St., North Station, and Lechmere through the use of portable wayside lifts. Construction of raised platforms which will be compatible with low-floor cars has been completed at four stations on the Riverside branch. Construction of raised platforms is planned at surface Key Stations on the B, C, and E lines. The two terminal stations of the Mattapan-Ashmont

line are also designated as Key Stations.

Work is presently underway to upgrade Orange Line stations at North Station, and Chinatown (out-bound). Orange Line stations at Malden and Community College will also be made accessible under the Key Station program. Design

work is presently underway to replace the Charles station facility on the Red Line, making it accessible. Although not designated as Key Stations, Red Line stations at Savin Hill, Fields Corner, and Shawmut are slated for major renovations which will include providing accessibility.

Work is presently underway to provide new improved Blue Line facilities at Airport and Aquarium which will be accessible. Design work continues to upgrade Blue Line stations at Maverick, State, and Government Center.

PARATRANSIT

The RIDE service is a paratransit program operated by private carriers under contract to the MBTA that provides transportation to people who cannot use fixed-route public transportation because of disabilities. The RIDE operates sedans and lift-equipped vans within the MBTA district in the following 62 municipalities:

Arlington, Bedford, Belmont, Beverly,
Boston, Braintree, Brookline, Burlington,



Cambridge, Canton, Chelsea, Cohasset, Concord, Danvers, Dedham, Dover, Everett, Framingham, Hingham, Holbrook, Hull, Lexington, Lincoln, Lynn, Lynnfield, Malden, Marblehead, Medfield, Medford, Melrose, Middleton, Milton, Nahant, Natick, Needham, Newton, Norwood, Peabody, Quincy, Randolph, Reading, Revere, Salem, Saugus, Sharon, Somerville, Stoneham, Swampscott, Topsfield, Wakefield, Walpole, Waltham, Watertown, Wellesley, Wenham, Weston, Westwood, Weymouth, Wilmington, Winchester, Winthrop, and Woburn

In FY 1999, annual ridership was over 1 million riders.

Overall, the RIDE program operates a fleet of over 300 vans and sedans to provide its services.

PRIVATE-CARRIER AND SUBURBAN BUS SERVICE

Five private carriers provide regular local bus transportation in East Boston, Winthrop, Peabody, Salem, Medford, Milton, Canton, Hingham, and Hull under contract to the MBTA. Annual ridership in Fiscal Year 1999 was 691,000 passengers.

Nine additional private carriers are subsidized through the MBTA's Inter-District Transportation Program (ITP) to provide commuter service to Downtown Boston from the following communities:

Amesbury, Andover, Barnstable, Bourne, Boxford, Bridgewater, Canton, Dighton, Dover, Duxbury, Easton, Fall River, Framingham, Georgetown, Groveland, Hanover, Haverhill, Hudson, Kingston, Lawrence, Marlborough, Marshfield, Medfield, Medway, Methuen, Middleborough, Middleton, Milford, Millis, Newbury, Newburyport, Northborough, Norwell, Peabody, Pembroke, Plymouth, Raynham, Rockland, Sandwich, Shrewsbury, Somerset, Southborough, Sudbury, Taunton, Topsfield, Wayland, West Bridgewater, Westborough, Worcester

The same program also finances local services from Framingham to the surrounding towns of Ashland, Holliston, Hopkinton, Marlborough, Milford, and Southborough, and a commuter service from Braintree Station to Hanover, Marshfield, and Plymouth. Annual ITP ridership for Fiscal Year 1999 was 522,800.

Nine private carriers also operate commuter service to Boston and are not included in the ITP. These carriers provide service to Abington, Acton, Braintree, Cohasset, Concord, Fairhaven, Fall River, Falmouth, Harwich, Hingham, New Bedford, Newburyport, Orleans, Scituate, Springfield, Wareham, Weymouth, Whitman, as well as locations in Rhode Island, New Hampshire, and Maine.

The MBTA also provides funding to local communities to operate their own local transit systems. The Suburban Bus Program is geared toward low density communities where regular MBTA service would not be cost-effective. The program, begun in 1979, subsidizes 11 communities: Bedford, Beverly, Burlington, Dedham, Framingham, Lexington, Lynn, the Mission Hill neighborhood of Roxbury, Natick, Needham, and Norwood. Some communities operate fixed-route bus service, while others use the program to operate demand-response service with vans or through taxi-vouchers. Annual ridership in Fiscal Year 1999 was 424,000 passengers.

Newton, Concord, Waltham, and Peabody operate local bus services which are not included in the Suburban Bus Program.

TRANSPORTATION MANAGEMENT ASSOCIATIONS

Transportation Management Associations (TMAs) are non-profit coalitions of local businesses dedicated to reducing traffic congestion and pollution and improving commuting options for their employees. The Boston and Cambridge TMAs each serve a specific business area, while the Suburban TMAs serve several businesses within their community. Several support shuttle services which connect employment locations with MBTA

rapid transit or commuter rail stations. While some of these services are only available to employees of member companies, others are open to the general public to ride. One of the most well established services is the Alewife-Route 128 Waltham shuttle operated by the Route 128 Business Council.

Cape Ann Transportation Authority

The Cape Ann Transportation Authority provides local service in the towns of Gloucester and Rockport, and also operates Saturday service from Gloucester to shopping centers in Danvers and Peabody. In 1997, the CATA fleet consisted of 12 buses and demand response vans. Annual ridership was 306,000 for bus service and 35,000 for vans.



ITS INTEGRATION AND THE MBTA

Intelligent Transportation Systems (ITS) has a number of useful applications with the provision of transit services. The use of ITS can help the MBTA provide a more user-friendly on-time service to its clients. The MBTA is integrating ITS into its operations in several ways. The Operations Control Center (OCC) was upgraded in the late 90s to provide improved monitoring and location information for the rapid transit system. This control center allows operators to have real-time information on service and accidents and plan service changes accordingly.

A new bus operations center will soon be added to the rapid transit facility which will integrate global positioning systems on its fleet of buses so that it can better schedule and direct its bus fleet. Automatic stop announcement equipment has been installed on the MBTA's crosstown bus routes. The MBTA's Silver Line buses will be

equipped with GPS-based Automatic Vehicle Location (AVL) technology.

The MBTA is moving forward with procuring new fare collection equipment. Both magnetic-strip fare media and contactless "smart cards" are being considered. The MBTA will have some elements of an automated fare collection system implemented by 2003.

The MBTA is preparing to release a Request for Proposals to provide interactive travel informa-

tion kiosks at the South Station Transportation Center (SSTC). These kiosks would provide a direct link to the MBTA's Web site where customers could access schedule information for all bus, rail, and boat service. New automatic trip planning functions are also likely to be added to the Web site during the next two years.

The MBTA is nearing completion of a request for proposals to provide an enhanced customer service information system. This system would be tied directly to the MBTA's new vehicle and driver scheduling software now being used by the Scheduling Department. This would allow customers to access next-trip information for all routes over the telephone or the Web. An itinerary-planning tool would also be available to customers on the Web, generating origin-destination routing suggestions without the aid of a customer service agent. Other improvements would include TDD capabilities for all customer service agents, in order to reduce telephone-waiting time for persons with hearing impairments.

BICYCLE ACCESS

As part of the "Bikes on the T" program, permits are no longer required to bring bicycles on

MBTA heavy rail and commuter rail trains. In the fall of 2000, bike racks were installed on 22 buses for use on Crosstown Routes CT1, CT2, and CT3. If successful, bicycle racks may be installed on other buses in the future. The MBTA has moved forward with plans to spend \$50,000 in enhancement money to increase bicycle parking facilities at stations.

REVERSE COMMUTING

The MBTA has initiated several new or enhanced bus services with access to jobs funding from the Federal Transit Administration. Service for reverse commuters is operated to Centennial Park in Peabody, Square One Mall in Saugus, Logan Airport, South Shore Mall in Braintree, business centers in Burlington and Bedford, and the Solomon Pond Mall in Marlborough. One of the important pieces of information that will be derived from the 2000 U.S. Census is how commuting patterns have changed in the past decade. With better information, the MBTA can adapt its schedules and routes to better serve the changing nature of the region's commuters.

SERVICE EVALUATION PROCESS

MBTA Operations is constantly monitoring service and trying to change or adjust service delivery according to the customer demand. The MBTA considers the following factors when considering service change requests:

- The rationale for the change
- Net cost per passenger
- Net cost per new passenger
- Existing and projected ridership
- The number of new transit riders
- Existing and projected operating costs
- Existing and projected fare revenue
- Added travel time for existing ridership
- Key characteristics and demographics of the market

- Contribution to the achievement of policy objectives
- Other factors as appropriate.

Requests for service changes and new services can be made by anyone—private citizens, elected officials, MBTA employees, or those representing neighborhood groups, business organizations, etc. Once received, they will be evaluated and reviewed by the Service Planning Department.

PARK-AND-RIDE FACILITIES

Within the Boston MPO region there are 117 park-and-ride facilities. These lots play an important role in reducing congestion in Boston's urban core by enabling individuals to drive short distances from their homes and gain access to other forms of transportation, such as commuter buses, carpools, and vanpools. Most of the lots are conveniently located in downtown centers or along major roadways. The MBTA, MassHighway, Massport, and Massachusetts Turnpike all operate park-and-ride facilities. The MBTA is by far the largest provider of commuter parking spaces.

A major constraint for the MBTA is the number of available parking spaces at park-and-ride facilities throughout the system and the limited amount of space available to expand these facilities. There are 76 commuter rail stations within the Boston region that have parking facilities. These lots typically charge \$1 per day, although there are exceptions. There is a wide variance in the vehicle capacity of the commuter rail lots. Route 128 Station can currently hold 2,100 vehicles, although 550 of these spaces are reserved for Amtrak passengers. Pride's Crossing, Plimptonville, and Silver Hill stations all have spaces for fewer than 10 vehicles. The total number of spaces available at Boston region commuter rail stations in 1999 was 16,600.

Of the 76 commuter rail park and ride lots, 60 were considered to be at capacity in 1999 according to the Congestion Management System's (CMS) Park-and-Ride Lot Utilization Status report. The MBTA considers parking facilities to be at capacity when they are over 85% full. Most

of the lots that were underutilized were smaller facilities with capacities of under 100 vehicles. The lone exception was Lynn, where the 965-vehicle facility (the commuter rail system's second largest) was observed to be only 31% full. The excess space in Lynn is primarily due to its location in an urban downtown that is not well served by the highway network. Another problem is the early time at which many of these lots reach capacity. Although no studies have focused primarily on this situation, there is evidence in the form of comments from commuters that travel schedules and even work hours have to be shifted in order to arrive at commuter rail stations early enough to secure a parking space. Limited parking results not only in commuters being forced to drive into Boston when they find a commuter rail lot to be full, but also in some commuters forgoing transit altogether due to the uncertain availability of parking.

Several projects are either under construction or being planned to help remedy this parking shortage. The largest parking project is the result of the relocation of Mishawum Station in Woburn to

combined parking capacity of 1,150 vehicles. Another six parking expansion projects will add approximately 1,000 more spaces of parking. Most of the new spaces are the result of guidelines established by the Department of Environmental Protection in the State Implementation Plan requiring that 20,000 new intermodal commuter parking spaces be created before the end of 2000.

It is projected that even with these new additions, the commuter rail network will continue to have the majority of its park and ride lots at or above capacity. This problem is compounded by the increased difficulty of locating additional land around existing stations for parking expansion. Many stations are located in town or city centers where vacant land for expansion is scarce. Stations that are located outside of busy commercial districts are now attracting development themselves, complicating the expansion of these sites as well. Others are bounded by protected wetlands. It is also becoming increasingly difficult politically to expand existing stations, as the areas around many stations suffer from commuter rail-

related traffic that originates from outside the town hosting the facility. Cost is another concern for the MBTA. The cost for each additional parking space can range from \$5,000 to

TABLE 5-3
Construction Costs for MBTA Commuter Parking Spaces

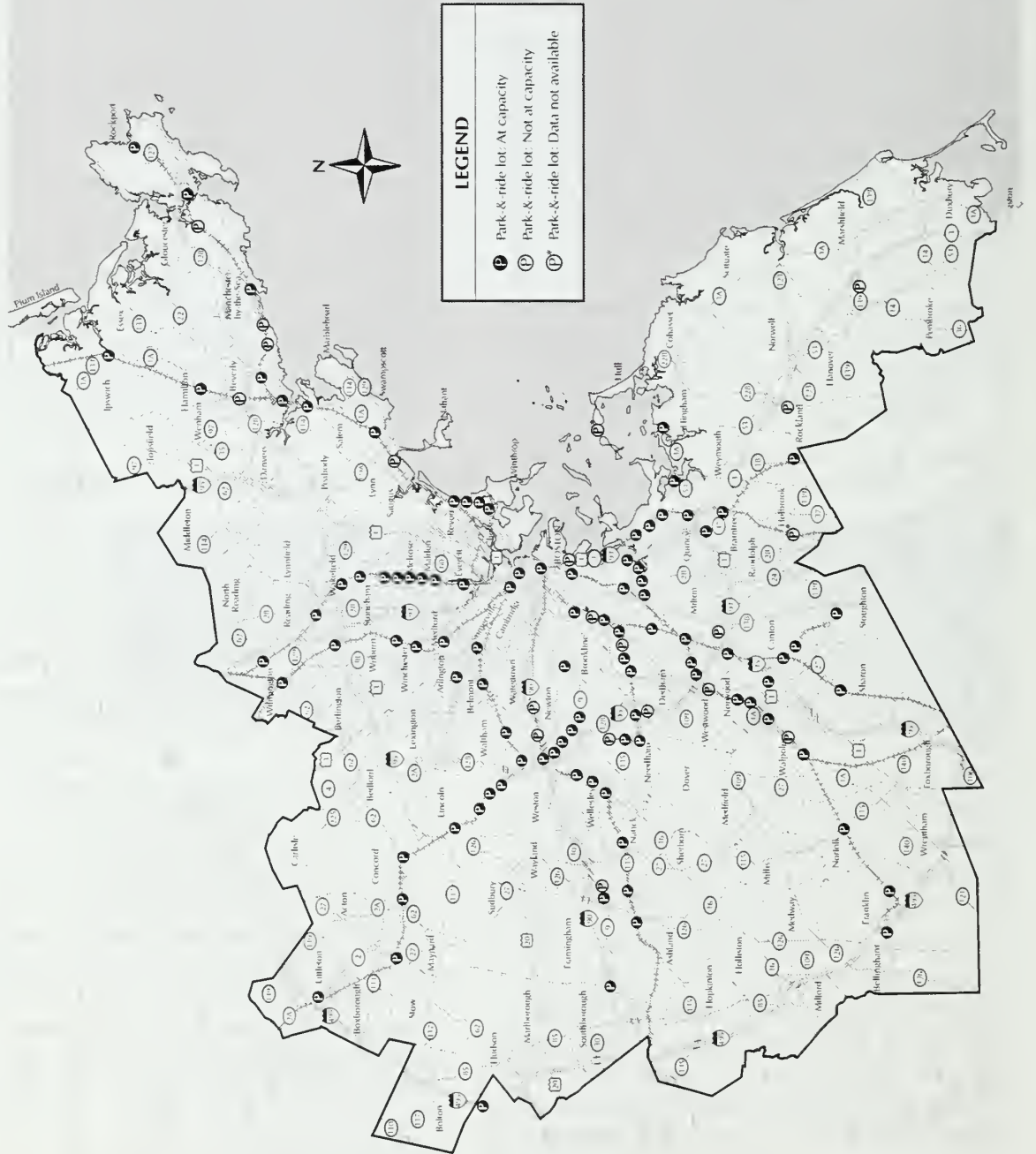
Type of Space	Range (\$ per space)			
Paved parking space	\$	5,000	to	\$ 6,000
Decked space	\$	10,000	to	\$ 15,000
Multi-story garage space	\$	15,000	to	\$ 19,000
Underground parking space	\$	25,000	+	

the Woburn Industriplex site. This new station will have a parking capacity of 2,400 vehicles, with some of this capacity being reserved for Logan Express bus service. The ongoing expansion of Route 128 Station will result in a total of 2,750 spaces, 550 of which will be reserved for long-term or Amtrak parking. The addition of three new stations over the next year between Framingham and Worcester on the Framingham Line, will also increase parking. Two of the four stations, Ashland and Southborough, are located in the MPO region. These two stations will have a

\$20,000 per parking space. This figure does not include the cost of land acquisition.

The MBTA's rapid transit system is the location of another 29 park and ride lots. Ten of these are on the streetcar system (Green Line and Mattapan High Speed Line) and the rest are on the three heavy rail lines. Parking charges at rapid transit stations are typically \$2.00 at surface lots and \$2.50 at parking garages. Alewife Station is \$4.00. The two largest parking facilities are on the Red Line. They are Quincy Adams (2,240 spaces), and Alewife (2,420 spaces). The total

MAP 5-3 Park-and-Ride Lots



number of spaces on the rapid transit system is 15,626. All of these parking facilities were considered to be at capacity by the MBTA's 85% standard, with the exception of the four Mattapan High Speed Line stations. These four stations—Mattapan, Milton, Butler and Cedar Grove—account for only 314 spaces. Since almost all of the MBTA's rapid transit stations are in dense urban areas, the difficulties for parking expansion are even more acute there than for the commuter rail system. There are currently no significant parking expansion projects underway or planned.

The remaining 12 park and ride lots are Logan Express lots, MBTA bus facilities, MBTA-contracted ferry depots, or private bus and van lots. With the exception of the Massport-operated Logan Express lots in Braintree, Framingham, and Woburn (this lot will be relocated to Woburn Industriplex) and the Hingham ferry boat lot, these additional park and ride facilities are all well below capacity. The ferry depots with parking facilities are located in Hingham and at Pemberton Point in Hull. MassHighway owns park and ride facilities at 7 locations in the Boston MPO region. These are located in Framingham, Rockland, Arlington, Milton, Pembroke, Canton, and Needham. Only the 450-vehicle facility in Rockland is at greater than 50% capacity.

One of the primary goals of the Regional Transportation Plan is to reduce congestion and VMT, and to improve air quality through an increase in

the use of transit. Estimates of modal splits for the year 2025 suggest that this is a realistic goal, as significant increases in the demand for commuter rail are projected. But unless the current scarcity of parking availability at commuter rail stations is addressed, the system will not be able to live up to these expectations. The Boston MPO and the MBTA need to continue to work with municipalities to address the barriers to locating new parking facilities. Improved coordination with other regional transit authorities is needed. The MPO must also take a leadership role in identification of funding sources for parking facilities when space for them is found. But the commuting patterns in the Boston region today necessitate more than simply creating parking around radial transit lines. In order to reduce congestion, the Boston MPO must also work with MassHighway to encourage the use of existing underutilized park and ride facilities for carpooling, vanpooling and private bus commuters, not only for travel into the core, but throughout the region. As space at Logan Airport continues to grow scarce, the use of satellite facilities like those currently maintained by Massport must increase. The new Woburn Industriplex is an example of the type of coordination between agencies and modes that is crucial to future of mobility in region. The Boston MPO needs to promote more integrated solutions like the Industriplex in the coming decades.

CONCLUSION

The past decade has seen an expansion of the commuter rail system with the opening of two of the Old Colony branches, the extension of the Ipswich branch to Newburyport and the extension of the Framingham commuter rail line to Worcester. In addition, almost 20,000 new parking spaces have been added to the commuter rail and rapid transit network.

The beginning of this decade sees the MBTA aggressively pursue the concept of Bus Rapid Transit (BRT) with the three components of the Silver Line (South Boston Piers, Washington Street, and the New England Medical Center to South Station connection) and other future proposals.

The financial future of the MBTA is dramatically different from even a year ago. The General Court has provided a dedicated funding source to the MBTA and it must now operate within this source of funding as well as assessments to member communities and farebox revenue. This has required a detailed examination within the MBTA of its priorities and what capital expansion projects it can ably program.

The recently completed Blue Ribbon Panel study of the future of the MBTA concluded that capital expansion, while necessary to satisfy the transit demands of the region, must in the future take a back seat to maintenance of the existing system. This plan does not include a large list of new transit expansion projects. Instead it first looks at the maintenance needs of the existing system. Fully 70% of all available capital funds available to the MBTA is programmed for maintenance. Chapter 11 discusses future MBTA financial assumptions based on the MBTA Finance Plan submitted in association with the authority issuing its own bonds for the first time. This conservative set of assumptions has formed the basis for this Transportation Plan. As noted in Chapter 11, the MPO is planning to review the assumptions to see if it is reasonable to expect additional capital funds in the future.

As the model results in Chapter 9 show, demand for transit will grow over the next twenty-five years. The subway system will be experiencing dramatic growth, with the greatest challenge coming to the Red Line and the Green Line central subway. This growth also necessitates additional capacity for both the north and south-side commuter rail systems. According to the model projections, upwards of 20,000 new commuter rail parking spaces will be needed in Eastern Massachusetts and the bordering states to satisfy demand for increased ridership on the commuter rail network. Increased commuter rail rolling stock and new bi-level commuter rail cars will also be necessary to satisfy this demand.

A third area of need is providing more reliable and frequent bus service, whether it be in the suburbs by shuttles or some form of locally-subsidized bus, or in the core by MBTA bus. As we move into the future, demand for suburban transit service grows greater. This need may not be well-served by a radial network of Boston as the hub and the suburbs as the spokes.

The work on the 2001-2025 Transportation Plan will need to focus on these areas to see what projects are best suited to further complement the existing transit system in the region. Certainly, the two large-scale projects to be further explored are the Urban Ring Transit system and the North South Rail Link.



CHAPTER

6

BICYCLE AND PEDESTRIAN TRANSPORTATION

We are discussing two modes in this chapter that have some things in common and are also quite distinct. Pedestrians use sidewalks; bicyclists use streets. Pedestrian mobility is determined by whether there are sidewalks available, and their condition, and by the safety and convenience of roadway crossings. Bicycle mobility is affected primarily by road conditions, and in some respects, bicyclists have more in common with motorists than they have with pedestrians. Both modes use trails.

Why promote walking and bicycling? They do not require combustible fuels and do not pollute; they are quiet; they are healthy; they are the most economical modes for users, and facilities to support them are relatively inexpensive; they are available to all age groups, all socioeconomic strata; and they are, according to reliable sources, very enjoyable.

Legislative and policy leaders at both the national and state levels encourage bicycling and walking. The following are policy statements of the United States and Massachusetts governments, respectively.

Bicyclists and pedestrians shall be given due consideration in the comprehensive transportation plans developed by each metropolitan planning organization and State... Bicycle transportation facilities and pedestrian walkways shall be considered, where appropriate, in conjunction with all new construction and reconstruction of transportation facilities, except where bicycle and pedestrian use are not permitted. (U.S. Department of Transportation, TEA 21 (Section 1202(a)(3)(1).)

As we enter the 21st century, walking in Massachusetts will become a viable transportation choice for more trips: to work and school, for shopping, and for visiting friends and family. Increasing numbers of people throughout Massachusetts, residents and visitors alike, will be able to walk safely and conveniently to their destinations. Pedestrians, bicyclists, and drivers will be aware of each other's needs, and will act appropriately for the situation in which they are walking, riding, or driving. Walking will increase, while accidents involving pedestrians will decrease. Street and sidewalk design will accommodate and give greater priority to pedestrians in ways that are responsive to local

situations and needs. More people will be involved in their communities to improve conditions and encourage more walking.

Physical improvements will be made to the pedestrian walkway system, encouraging more people to walk. More transit users will have the option to walk to and from local transit stops to more destinations with fewer conflicts and impediments. More malls and shopping centers will be more accessible to pedestrians, and town centers and downtown shopping districts will flourish. More walkers will know how to walk safely on rural roads, and learn how to share paths. More drivers and bicyclists will be aware of pedestrians and share roads and off-road facilities with them. More new development will occur in places that are within walking distance of activity centers to create increased opportunities for walking. (Massachusetts Pedestrian Plan, prepared for MassHighway by Wallace, Floyd, Associates, Inc., 1998, p 2-2.)

The vision of the Statewide Bicycle Transportation Plan is recognition of bicycling as a viable means of transportation and reasonable accommodation of the needs of bicyclists in policies, programs, and projects. Greater recognition and accommodation of the needs of bicyclists will lead to a more balanced transportation system with greater modal choice and improvements in bicycle safety. Such actions will enhance the environment

and quality of life in the Commonwealth, and improve personal mobility.

Bicycling is also a highly efficient means of transportation as well as a healthy, enjoyable activity for people of all ages. (The Surgeon General has found that a regular, preferably daily, regimen of at least 30-45 minutes of brisk walking or bicycling can lead to improved health.) For all these reasons, bicycling should be encouraged and promoted so that more people will choose to bicycle. Improving facilities for bicycling will lead to greater use of bicycles and an increase in the attendant benefits to citizens, communities, and the Commonwealth.” (Massachusetts Statewide Bicycle Transportation Plan, prepared for MassHighway by VHB, 1998, p. 3.)

How do we accomplish the above visions? We improve upon a transportation system that is already, in some places more than others, conducive to these modes. That means a comprehensive system that facilitates pedestrians and bicyclists going to both primary destinations and other modes. Ongoing efforts to improve conditions for bicycling and walking in the Boston MPO region have been encouraged and bolstered by citizen involvement, especially through the Massachusetts Bicycle Coalition (MassBike) and Walk Boston.

MAP 6-1
Dr. Paul Dudley White Bike Path



EDUCATION, ENFORCEMENT, ENCOURAGEMENT, ENGINEERING

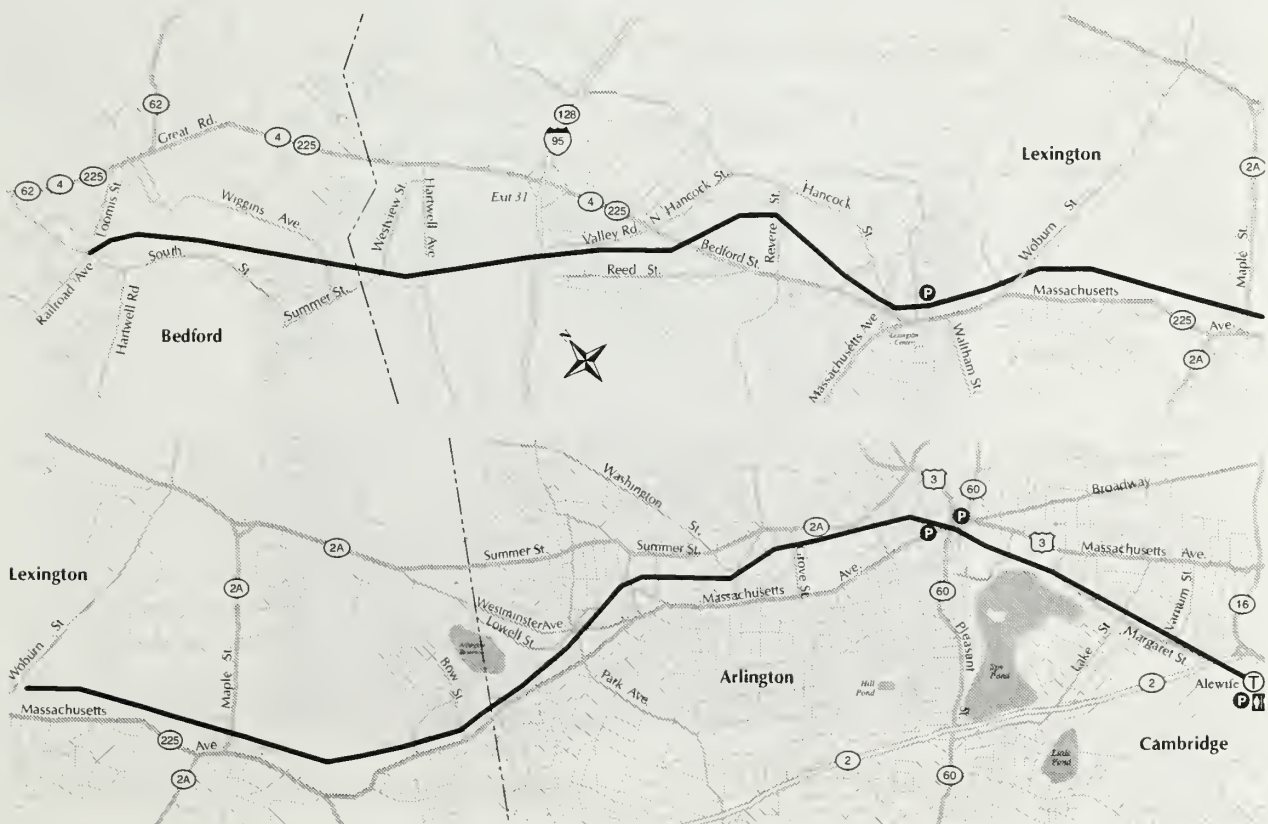
Issues related to bicycling and walking are often divided into the four E's of education, enforcement, encouragement, and engineering. The focus in this Transportation Plan is on engineering issues. Education, enforcement, and encouragement are also very important, however, and particularly so for these two modes. In the area of education, there is no formal requirement for pedestrians or bicyclists. At least motorists must reach a minimum age and pass a competency examination. The lack of education means bicyclists often do not know how to predictably and safely maneuver in traffic. A program called Effective Cycling, and offered through MassBike, goes beyond traditional bicycle education and teaches a bicyclist how to maneuver in traffic safely and predictably, and how to deal with emergency traffic situations. Likewise, motorists need to understand pedestrians' rights, and that

bicyclists have rights that are equal to motorists on all but limited-access roadways.

Efforts have been made and need to continue to enforce traffic laws, as Cambridge has done. A lack of enforcement results in many bicyclists and pedestrians taking chances because of virtually no risk of tickets. Likewise, traffic enforcement to protect the rights of bicyclists and pedestrians is rarely a priority. More local police departments are using bicycle patrols, which is beneficial in that officers on bicycles experience firsthand the joys and challenges of that mode.

In regard to the fourth 'E,' encouragement, it is likely that some people reading this report have not bicycled since childhood. The bicycle is used as an important, often primary, mode of transportation in much of the rest of the world, including Europe. Americans often use motor vehicles for trips that could be made by foot or by bicycle. Bicycle or walk? We are not used to it, it seems like too much trouble, or it doesn't occur to us unless we're at the gym. No room at the com-

MAP 6-2
Minuteman Commuter Bikeway



muter rail lot? Rather than bicycling (and then parking for free, space guaranteed), we drive all the way to work. Due to the “cold-start” phenomenon, motor vehicles pollute much more when cold than when they are warmed up. It would be much better for the environment if the shorter motor-vehicle trips to transit stations could be eliminated in favor of walking and bicycling.

BICYCLE AND PEDESTRIAN MODAL SHARES

According to the 1990 journey-to-work U.S. Census data, about one percent of the residents in the Boston MPO region bicycle to work. This U.S. Census estimate is considered low, for several reasons. First, the census does not include students, of which there are many in the Boston region. Second, the census surveys are conducted in March, a time of the year when bicycle ridership is relatively low. Third, people who use the bicycle once or twice a week, or who walk or bicycle to a transit stop, are not captured. Communities in which more than one percent of the population bicycle to work are Cambridge (3%), Somerville (2%), and Brookline (1.8%).

About seven percent of residents in the Boston MPO region walk to work. No data for seasonal variations in walking are available for the Boston region. Communities with walk shares over ten percent are Cambridge (25%), Wrentham (17%), Boston (14%), Wellesley (12%), Brookline (12%), and Somerville (11%). These data do not include those who walk to public transportation.

TRAILS

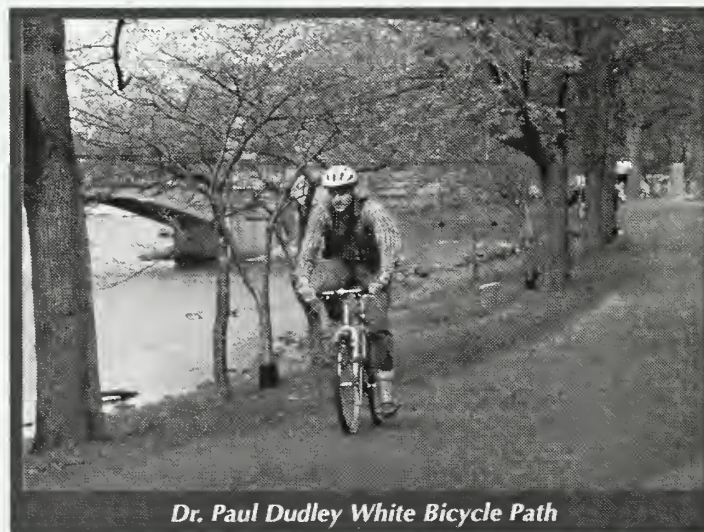
Trails are used by all non-motorized modes: bicyclists, walkers, skaters, joggers, and users of wheelchairs (which can be motorized) and baby

carriages. Trails are used not only by experienced commuter bicyclists heading to work, but by novice adults and children, who, by using trails, might gain the confidence and experience necessary to travel on-road. Even with a significantly expanded network of trails in the Boston area, they can serve only a fraction of all trips.

Trails are usually built on railroad rights-of-way or along natural corridors such as rivers. Two major trails in the Boston MPO area are built along a river and rail, respectively.

- The Dr. Paul Dudley White Bicycle Path is located on both sides of the Charles River between the dam at the Museum of Science in Boston and Watertown Square. The MDC has extended a path on the north side of the river from Watertown Square to Waltham.
- The Minuteman Commuter Bikeway extends from the MBTA's Alewife Station in Cambridge through Arlington and Lexington to Bedford, on the MBTA's Bedford Branch. There is a linear park from Alewife Station to Davis Square in Somerville.

Other trails include the Muddy River Path (Brookline and Boston), the Southwest Corridor (paralleling the MBTA's Orange Line), Frederick Law Olmstead's Emerald Necklace, and MDC trail sections along the Mystic and Neponset Rivers.



Trails allow users to be separated from motor-vehicle traffic. Except at the intersections, the noise, fumes and collision-concerns associated with combustible engine vehicles are gone. While great care has to be taken at the intersections, the nature of most trails means there are fewer of them. For

example, a traveler on the Charles River Path

needs to negotiate five intersections to go from the Museum of Science to Watertown Square. On the road system, that traveler would need to go through about forty intersections. Also, an on-road cyclist probably would pass hundreds of parked cars; the path cyclist might not have to pass any. The hazard of a parked car is the potential of a driver (or passenger on the driver side) opening the door unexpectedly in front of a passing cyclist. (This is an event which a well-trained cyclist would handle very differently than an untrained one).

A disadvantage of a trail is that it is generally slower for an experienced cyclist. The cyclist cannot go fast on the trail in consideration of slower users, and must yield at all crossings. Also, on trails a cyclist has to contend with dogs, leashed or unleashed, and the sometimes unpredictable movements of pedestrians and joggers. Bicyclists who travel too fast, pass too closely, or give no warning before passing make trail use uncomfortable for others.

In general, trails have proved to be very popular with a wide range of people. Proposed regional trails in the Boston area include the following (see Map 6-3):

- Bike-to-the-Sea (on the Saugus branch, from Lynn to Everett),
- the Tri-Town Bikeway (Winchester, Woburn, and Stoneham),
- Border to Boston (Newburyport branch and Eastern Route main line; Danvers to New Hampshire)
- Assabet River Rail Trail (Marlborough branch, to South Acton),
- Central Massachusetts (Berlin to Belmont, called the Wayside Trail),
- Lowell-Sudbury (and possibly south to Framingham; northern part is the Bruce Freedman Trail),
- Upper Charles (Framingham to Medway),
- Minuteman-Charles River connector (via the Watertown branch).

The MBTA has recently indicated that it will make rights-of-way available to communities for trails, either on a permanent or an interim basis, depending on whether the MBTA sees a potential future use of the land. (The Minuteman Bikeway, for example, is on MBTA land). There is also potential for trails alongside active rights-of-way, with appropriate safety measures, and these need to be examined on a case-by-case basis.

There is one major signed bicycle route in this region, the Claire Saltonstall Bikeway, between Boston and Cape Cod. Most of this route is on-road, with trail segments included where possible. This route was re-signed in 2000 by MassHighway.

Besides large regional facilities, there is also the potential for short trails to improve mobility and safety for walkers and bicyclists. A potential rail right-of-way connection in Wellesley to Riverside Station is an example of this type of improvement. Other possibilities occur where neighborhoods are cut off from each other because of the road layouts: to decrease through traffic, these neighborhoods end in cul-de-sacs. Short trails connecting these cul-de-sacs would allow only non-motorized access.

ROAD TRAVEL

Improvements for bicyclists and pedestrians can be done during road reconstructions. Types of possible improvements include minor widening, especially in areas where a road narrows, new lane markings to favor a wider curb lane, dedicated bicycle lanes, new or improved sidewalks, and improved geometrics at intersections to facilitate bicycle travel and pedestrian crossings. Chapter 90E, Section 2A, of the General Laws (Chapter 87, Acts of 1996) requires consideration for bicycle and pedestrian traffic needs whenever feasible. (Section 2A: The Commissioner shall make reasonable provisions for the accommodation of bicycle and pedestrian planning, design, and construction, reconstruction or maintenance of any project undertaken by the department. Such provisions that are unreasonable shall include, but not be limited to, those which the commissioner,

after appropriate review by the bicycle program coordinator, determine would be contrary to acceptable standards of public safety, degrade environmental quality or conflict with existing rights-of-way.)

The intent of this law is to make it as safe as practical for bicyclists and pedestrians. The intent of this law is not to widen every roadway in Massachusetts to two-twelve-foot lanes plus shoulders, taking trees, stone walls, and local character in its wake. In some circumstances, widened roads can encourage higher vehicular speeds, possibly contributing to less safe conditions for pedestrians and bicyclists. Part of the joy of bicycling or hiking in Massachusetts is finding those meandering local roads.

The most common on-road mobility constraint for bicyclists is lack of operating space. The law needs to be implemented with an eye to how an existing situation could be made better, given other constraints. Room for bicyclists can be provided by bicycle lanes, paved shoulders, by wide outside travel lanes. Cambridge has installed bicycle lanes, to denote areas of the roadway that are earmarked for bicycle use.

On a two-lane road, space can be taken from the travel lane and added to the shoulder by striping. On a four-lane road, space can be provided by reducing the width of the inside travel lanes and adding that to the outside travel lanes. According to the American Association of State Highway and Transportation Officials (AASHTO), an outside lane width greater than 12 feet (3.6m) better accommodates bicycles and motor vehicles, and recommends an outside-lane width of 14 feet, a width not commonly found in the metropolitan Boston area. For more information, see *Guide for the Development of Bicycle Facilities*, American Association of State Highway and Transportation Officials, 1999.

Pavement problems, including potholes, other pavement deterioration, especially at edges, and abrupt drop-offs at the edge of pavements, are much more critical to bicyclists than motorists because bicycles are single-track vehicles with

relatively narrow tires. A particular problem is the substandard repaving often done after roads have been dug up for conduits or pipes; these excavations usually occur in the portion of the roadway used by bicyclists. Other problems include drainage grates with openings parallel to the road that catch bicycle tires; traffic-signal actuators that do not detect bicycles; and yellow lights that do not allow sufficient time for bicyclists to traverse an intersection.

Bicycle suitability maps and guides provide information to users and can help in planning future transportation projects. At both the regional and local levels, a map can help uncover areas where improvements are needed and where such improvements could make a large difference in bicyclists' ability to circulate. The following maps and guides have been printed and are available for purchase through local bicycle shops and bookstores:

- Boston's Bikemap (privately printed; inner metropolitan area)
- MetroWest Bicycle Map (publicly printed; thirteen communities west of Boston)
- Massachusetts Bicycle Guide (publicly printed; trail facilities, intermodal connections)
- Massachusetts Bicycle Map (privately printed; four maps covering the state).

An ongoing project at the Boston MPO is a comparison of the above MetroWest Bicycle Map ratings with the FHWA's index of bicycle compatibility. This project will use the FHWA model to rate the same roads that were rated subjectively by the MetroWest Bicycle Committee that produced the map.

One way to look at the issue of bicycle and pedestrian circulation is to ask if there are physical barriers to bicyclists, pedestrians, and other non-motorized travel. There are natural barriers such as rivers or lakes, where the expense of bridge or tunnel construction results in relatively few opportunities to cross. There are also man-made barriers, such as express highways or large

developments, that restrict bicycle or pedestrian access. There are also natural barriers such as snow that are exacerbated by man. Often snow is piled on sidewalks rather than removed from them, forcing pedestrians out into the street, where the width is already lessened, the road conditions may be poor, and at a time of year when more travel occurs during darkness. Going out of ones' way to get around these barriers requires more effort and time for a bicyclist than a motorist, and even more for a pedestrian. Second, the resultant crossing points often attract large volumes of traffic, sometimes becoming barriers themselves.

SAFETY ISSUES

Bicycling in traffic is relatively safe for those who know how. This would not be a controversial statement to experienced bicyclists, but probably is to those who never bicycle in traffic. Most transportation decisions are made by those who drive, and at least occasionally walk, but probably never or rarely bicycle. And yet it would be unimaginable to have our roadway system designed by people who do not drive.

The most experienced bicyclists do have fewer crashes. The importance of education, enforcement, and encouragement mentioned above need to be stressed. From an engineering point of view, how to we increase safety? One way to measure relative safety is to look at crash data. Even with limitations (incomplete location information and virtually all of the reported crashes concern collisions with motor vehicles and do not include falls), it is useful to determine the locations where large numbers of crashes occur.

An important question is why certain locations have higher numbers of crashes than others. Higher levels of motor-vehicle traffic, pedestrians, and/or bicyclists could be a factor. "Exposure

rates" take these volumes into account and indicate the number of accidents per given level of traffic. If such rates were available, they would highlight areas that have particularly high numbers of crashes due to factors other than simply high levels of traffic.

Even without exposure rates, high crash locations ought to be studied to find out what design, operational, or enforcement steps need to be taken. Also, it is important to remember that a low number of reported crashes at a location is not necessarily an indication of safety. It may be an intersection that is perceived as particularly dangerous by bicyclists and pedestrians and avoided.

The five locations indicated in Figure 6-1 have the highest number of pedestrian crashes (1995-1997) in the Boston MPO region. As stated above, all these crashes involve a motor vehicle.

FIGURE 6-1
Highest Pedestrian Crash Locations (from 1995 to 1997)

Community	# Accidents	Location
Brookline	10	Beacon @ Harvard
Cambridge	7	Mass. Ave. @ Somerville Ave.
	6	Bishop Allen Dr. @ Prospect
Framingham	6	Edgell Rd. @ Worcester Rd. (Rte. 9)
	6	Park @ Concord

As shown in Figure 6-2, about a fifth of pedestrian crashes (statewide, in 1995) occurred at intersections, with another fifth within 300 feet of an intersection. About another fifth occurred walking in the street, about half against traffic and half walking with traffic. It is not known whether or not there were sidewalks.

There are many locations in the Boston MPO region without sidewalks on either side of the road. Some believe that unless pedestrian volumes are high, sidewalks are not necessary. On the other hand, we build roads that carry low volumes of traffic simply to provide access. With the

same criterion applied to pedestrians, a sidewalk is required anywhere where pedestrians need to be accommodated. If volumes are expected to be low, than a facility could be placed on one side only, with crossings provided as necessary.

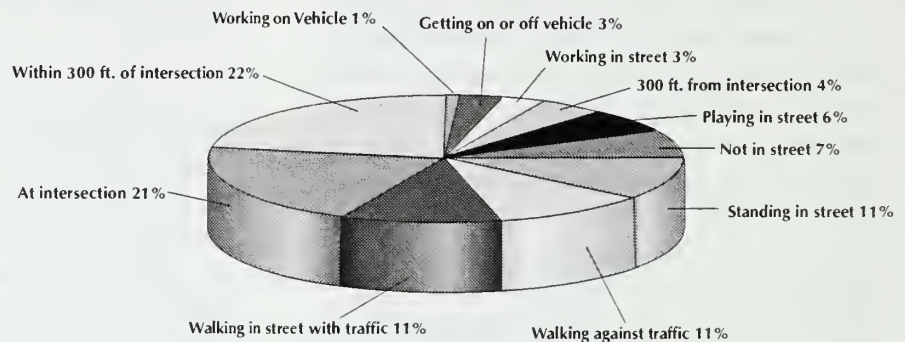
There are no "top five" locations for bicycle crashes. Figure 6-3 indicates the twelve locations with more than three bicycle accidents. Two locations in Cambridge have six crashes, and ten locations, in Cambridge and elsewhere, have four. (There are undoubtedly other locations that would be in these lists if better information were available.)

ACCESS TO OTHER MODES

Because bicycling and walking are most popular for trips under five miles and one mile respectively, they are used often to connect to other modes. Those who bicycle to the transit connection either park their bicycle or take it on board. There are parking facilities at most MBTA stations, and they are added as a matter of course during station reconstructions. The parking facilities are racks, although there are now bicycle lockers available at the South Acton station on the Fitchburg/South Acton commuter rail line and Salem on the Rockport line. Important issues to consider in locating bicycle parking are security, accessibility, and protection from weather.

The hours of bicycle access onto the three rapid transit lines (no access on the Green Line) include

FIGURE 6-2
Location of Pedestrian at Time of Accident (Massachusetts)



Note: Sample includes all accidents involving pedestrians where location of pedestrian was indicated. Location was not reported for 46 % of the accidents.
Source: Highway Management System, Massachusetts Highway Department/ Registry of Motor Vehicles, 1995.

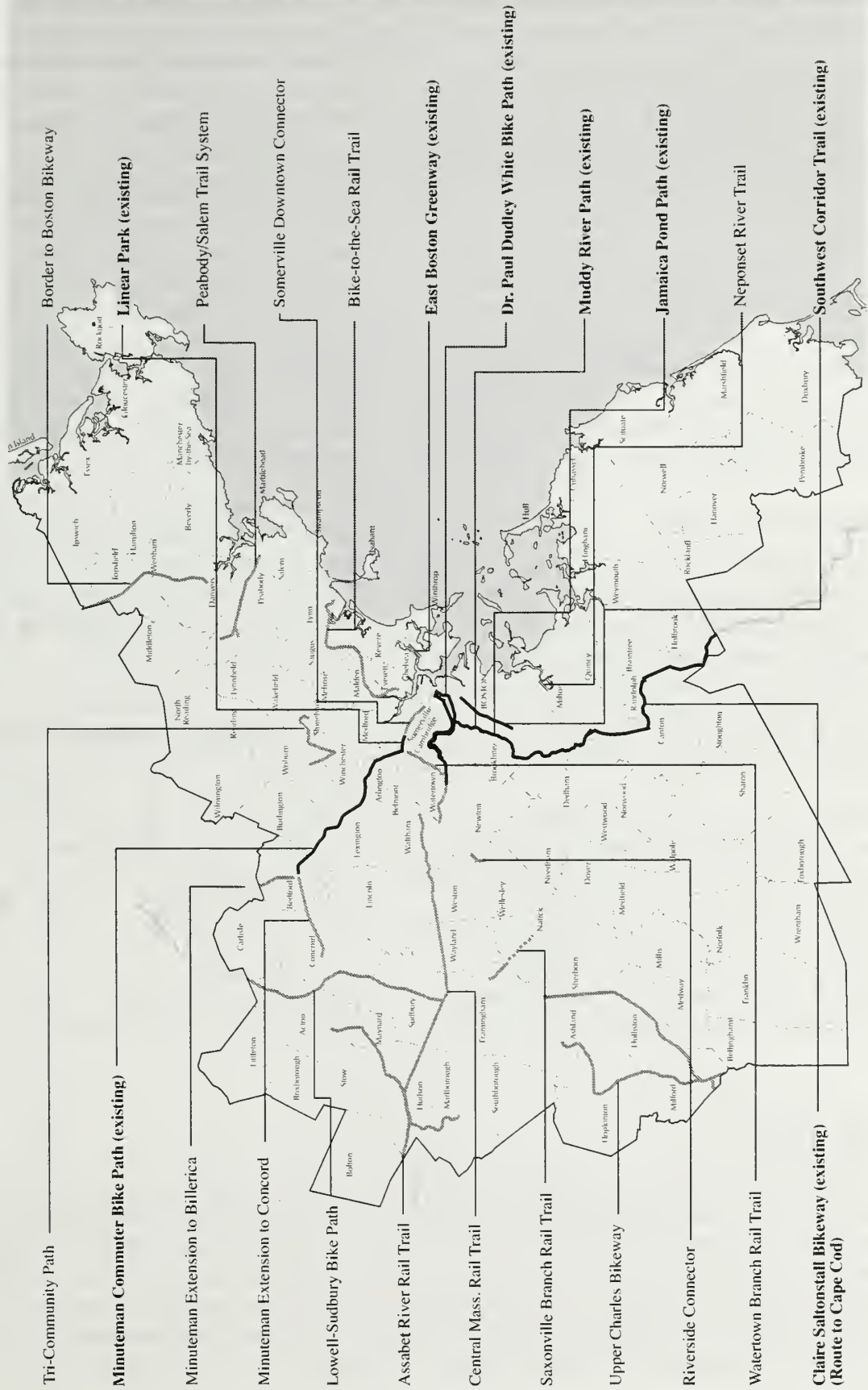
FIGURE 6-3
Highest Bicycle Crash Locations (from 1995 to 1997)

Community	# Accidents	Location
Cambridge	6	Columbia @ Hampshire
	6	Mass. Ave. @ Memorial Dr.
	4	Mass Ave. @ Walden
	4	Mass Ave. @ Amherst
	4	Cardinal Medeiros Ave. @ Hampshire
	4	Broadway @ Third
Framingham	4	Hollis @ Concord
Boston	4	Soldiers Field Rd. @ Western Ave.
	4	Old Colony Ave. @ Preble
Waltham	4	Main @ Prospect
Somerville	4	Joy @ Washington
Salem	4	Lafayette @ Ocean Ave.

all day Saturday and Sunday, midday (10 A.M. to 2 P.M.) during the week, and week nights after 7:30 P.M. Bicycles are allowed on all off-peak commuter rail trips. There is no additional fee for the bicycle. The MBTA eliminated the need for a bicycle pass in October 2000 on a three-year experimental basis and for the first time provided racks on MBTA buses (Crosstown routes). The rack on the front of the bus accommodates two bicycles.

Access on private buses is a matter of company policy. On the private carriers, the bicycle would be stowed in the baggage compartment. Bicycles

MAP 6-3 Existing and Proposed Bicycle Facilities



are also allowed on the ferries serving Boston Harbor. Some ferry companies charge a fee.

Improving access to and allowing bicycles on other modes can increase ridership on these modes. Take commuter rail as an example. Most commuter rail parking lots are full early in the morning. Someone bicycling to the station can arrive at any hour and park. Compared to walking, the bicycle increases the distance one can travel in a given amount of time. Someone who lives too far to walk to a station might consider bicycling. Likewise, the trip on the other end might be too long for walking, or inconvenient for transit, but possible by bicycle. During times of congested motor-vehicle traffic, the bicycle is often a quicker mode for trips up to a few miles.

TRAFFIC CALMING

The term traffic calming is used to denote a variety of measures to make streets safer for all users – motorists, and those on foot and bicycle. Slowing down motor vehicles reduces the chances of collisions. And if a collision occurs, the slower the speed of the motor vehicle, the less severe the damage to the bicyclist or pedestrian (see Figure 6-4).

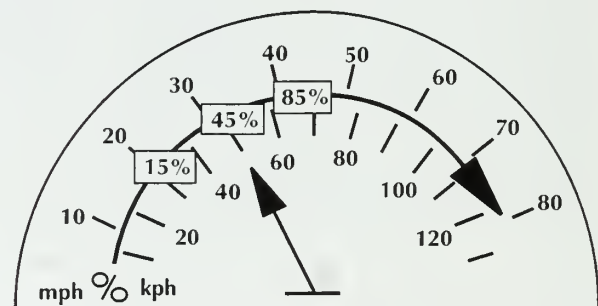
The City of Cambridge has been active in the area of traffic calming. Raised crosswalks and intersections have been installed in selected areas, with pavement markings and changes in surface materials, to warn and slow motorists. There are measures which are technically pedestrian improvements that also have a traffic calming effect. Many communities have placed YIELD

TO PEDS IN CROSSWALK signs in the middle of crosswalks to reinforce the law. Cambridge, Boston, and Wellesley have installed traffic signals that show, instead of the flashing DON'T WALK sign, a countdown of the number of seconds remaining to cross.

Other measures include safety islands, so pedestrians can have a refuge when crossing wide streets; and curb extensions, which increase the visibility of the crossing area, reduce the distance the pedestrian must travel to cross the road, and decrease the speed of motor vehicles. The targeted enforcement of motorists regarding pedestrian safety, as the Boston Police Department did this summer, is another example of tools that complement traffic calming.

It is worth stressing that these traffic calming measures are not only to increase the safety of an area, but also to make an area more pleasant for those living and working there. It is a group of measures that puts the emphasis on being in a place, not getting through it.

FIGURE 6-4
Chance of Pedestrian Fatality



Source: "Killing Speed and Saving Lives," United Kingdom Dept. of Transportation

CONCLUSION

The Boston MPO should build upon the steps that have already been taken to improve the transportation network for bicyclists and pedestrians. MassHighway, in conjunction with local communities, should make new and reconstructed roads as safe as practicable for bicyclists and walkers. This could include narrower travel lanes that would have the effect of slowing through traffic, allowing more shoulder room for bicyclists, and more buffer space for pedestrians. All roads that would attract any pedestrian traffic also need provisions for pedestrians on at least one side of the road. Trails have proved to be very popular with both bicyclists and pedestrians. Relevant agencies need to resolve right-of-way and funding

issues so that locations for new trails can be identified and so that the regional proposals that have been recommended through feasibility studies (Central Massachusetts, Assabet River, Watertown Branch, Upper Charles, Border to Boston) and the extensions of the Dr. Paul Dudley White and Minuteman Paths can move forward. By siting bicycle racks in covered areas and by providing lockers, bicycle parking can become more secure and convenient for users. Improved facilities for bicyclists at transit stations, airports and ferry terminals are other important investments. Advisory boards for both bicycle transportation and pedestrian transportation need to be established under EOTC.



CHAPTER 7

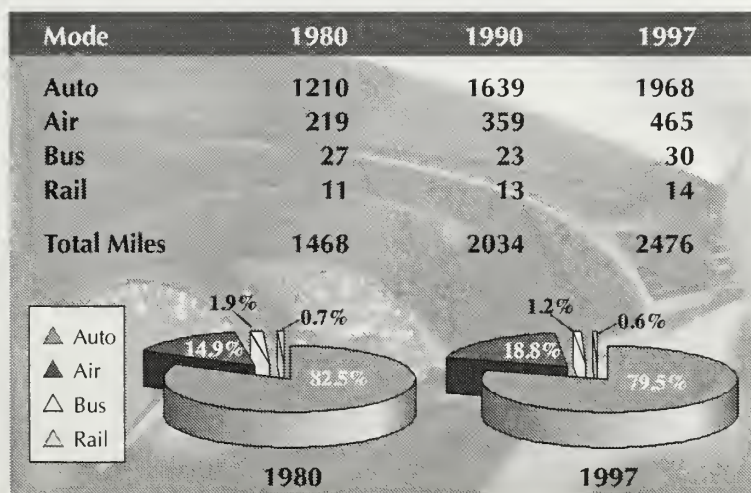
INTERCITY TRAVEL

The importance of passenger travel between cities is particularly acute in the densely populated New England and Northeast Corridor regions. The Boston region is the largest urbanized area in the six-state New England region. As such, it is of significance to intercity travel in New England both as the major trip generator and as the transportation hub for many trips in which Boston is not the point of origination or destination. Based on 1999 figures, Boston's Logan International Airport carries approximately 64% of all commercial air passenger trips that pass through the New England passenger airports studied in this report, although the Boston area's population comprises only about 25% of the six states' total.

The Boston region is also the northernmost major metropolitan area in the Northeast Corridor. This corridor, which encompasses Washington, D.C., Baltimore, Philadelphia, New York City, Boston and the smaller urban areas in between, has historically generated more intercity travel than any other region of the nation. Even as the population of the United States has dispersed to the south and west, the size and proximity of its cities to one another has kept the Northeast Corridor as the nation's largest generator of intercity traffic.

Boston's location at the northern end of this corridor has led to its being a termi-

FIGURE 7-1
Domestic Intercity Passenger Miles by Mode
(Billions of Passenger Miles)



nus for most of the intercity bus and rail traffic coming through the region from New York City and points south. Boston's proximity to New York City, the nation's largest metropolitan area, has created a situation where air, bus, and rail frequencies between the two cities surpass the levels seen in almost every other city pair in the United States outside of the Northeast Corridor. Automobile traffic on the major highway routes heading south along the corridor is also greater than that observed on other intercity highways between metropolitan areas outside of the region.

As the region's roads and airports continue to grow more congested, the development of a regional strategy that provides travelers with a variety of options becomes imperative. This strategy must take a multimodal approach that also addresses the constantly evolving needs facing today's traveler. Important steps have already been taken by the Boston MPO region. The new South Station Intermodal center provides the types of seamless intermodal connections necessary to attract travelers to transit. The resulting increase in intercity bus travel demonstrates the effectiveness of this investment. Implementation of the Fast Lane program on the Massachusetts

Turnpike and the bridges and tunnels of Boston have aided the Commonwealth in collecting needed revenue without increasing congestion and delays for the region's highway users. And efforts by the Massachusetts Port Authority to partner with competitors in an effort to efficiently distribute the demand for air travel throughout the region have already created benefits in the form of increased choice for the region's travelers. A continuation of efforts such as these is the key to maintaining the viability of the regional travel network.

REGIONAL AIRPORT NETWORK

The introduction of low-cost airlines, such as Southwest, MetroJet and Shuttle America, into the Northeast and their use of traditionally smaller regional airports has changed the dynamics of air passenger travel for New England. Although Logan International Airport carries the vast majority of the Boston region's passenger air traffic, events over the past five years have shifted most of the growth in air passenger travel to other regional airports.

Over the past three years there has been a 22% increase in passengers served by the regional air-

ports of New England. In contrast, passenger activity at Logan Airport grew by only 8%. This increase has come mostly at the newly expanding airports of Manchester, New Hampshire and T. F. Green, Warwick, Rhode Island. For purposes of this discussion, Bradley Airport, Hartford, Connecticut, was not included in this discussion due to its distance from Boston.

FIGURE 7-2
1999 Passenger Activity at New England Regional Airports and Logan Airport¹

Airport	Passengers (millions)	Percent of Total	Change from 1996
Logan Airport	27.05	63.4%	8%
Hartford Bradley, CT	6.30	14.8%	19%
T.F. Green, Warwick, RI	5.10	11.9%	105%
Manchester, NH	2.80	6.6%	180%
Portland, ME	1.37	3.2%	20%
Worcester, MA	0.04	0.1%	24%
Hanscom, MA	0.02	0.1%	—%
TOTAL	42.69	100.0%	22%

¹ Regional airports in Bangor, ME, Burlington, VT, New Haven, CT, and New Bedford, MA were excluded due to their small market share and lack of influence on Boston travelers' decision-making process.

Note: Commercial flights did not operate from Hanscom in 1996.

MAP 7-1
Intercity Travel



Logan Airport

Boston's Logan International Airport, located in East Boston, is by far the largest passenger airport in New England. The facility is owned and operated by the Massachusetts Port Authority (Massport). Logan's 494,816 aircraft operations in 1999 ranked it the 12th busiest airport in the United States. The vast majority of these operations, 97.8%, were passenger aircraft operations. In terms of passenger volume, Logan is the 18th busiest facility in the United States, and the 29th

busiest in the world. Logan served 27 million passengers in 1999, a 2% increase over 1998.

Logan's passengers have 63 regional, national, and international airlines to choose from, providing direct service to more than 100 airports in the United States and abroad. New York City is by far the most popular destination for planes departing Logan, with over 30,000 of 1998's total of 233,411 passenger departures bound for the nation's largest city. Washington, Philadelphia and Chicago were other popular destinations as

each generated more than 10,000 departing flights in 1998. Over 15% of the passengers served by Logan were on international flights. International growth from 1998 to 1999 was 7.7%, a considerably faster rate of growth than in the domestic market.

Access to Logan Airport is greatly facilitated by its location less than two miles from downtown Boston. Air passengers can choose from a wide range of private and public modes and services when travelling to the airport. Logan Airport ranks behind only San Francisco in the U.S. in terms of the percentage of air passengers using public transit for their trip to the airport. Approximately 18.6% of those traveling to or from Logan use public transportation to get there. 2.9 million of these travelers access the airport via the MBTA's Blue Line rapid transit service. Massport provides free shuttle bus service between Airport Station on the Blue Line and all airport terminals.

eral other locations. Taxi service provides another alternative to driving to Logan. In 1999, about 1.96 million taxis were dispatched from Logan carrying arriving passengers.

Automobile trips account for the majority of the remaining trips in and out of Logan Airport. Since 1991, the Massachusetts Department of Environmental Protection has enforced a parking freeze at Logan which caps the number of total spaces at 19,315.

Of those spots, 14,090 are reserved for commercial use (primarily air passengers) and the rest are allotted to airport employees. The majority of commercial spots are used for short term parking. Of the 3.1 million parking exits in 1998, 2.1 million were for automobiles that had been parked for less than four hours.

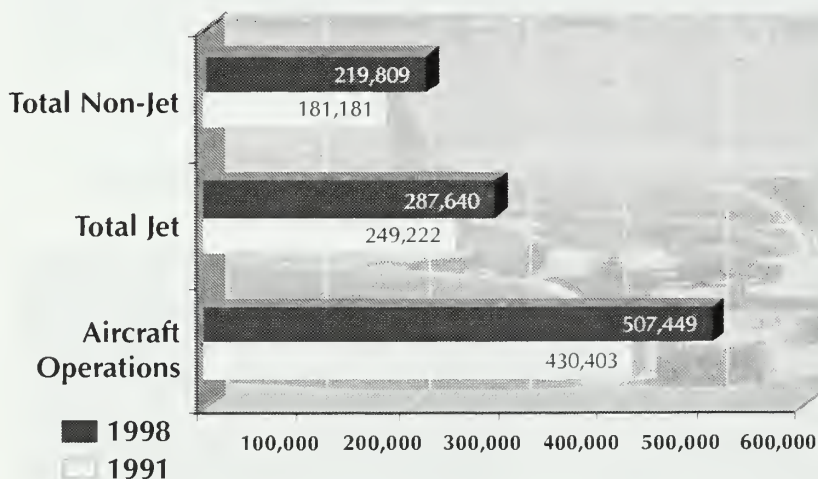
Improvements to alternatives to Logan over the next few years will divert some of the passenger traffic growth away from the airport. Smaller

regional airports in New England have grown from carrying 30% of the passenger market in 1995 to 39% in 1999. This growth is expected to continue, and by 2010 it is projected that an additional 3.4 million passengers will be diverted from Logan to these regional airports. Rail projects like Amtrak's high-speed rail, and service to Portland are projected to divert another 1.22 million passengers annually from shorter Logan Airport flights.

Investments in access to Logan Airport will help the facility serve the growing number of air passengers

expected in the upcoming decade. The ability for Logan to grow to meet its expected demand of 34 million by 2010 and to 37.5 million passengers per year by 2015, is becoming increasingly strained by delays at the airport. Recent forecasts of growth for Logan are lower than past years due to the growth of other regional airports serving the Greater Boston market. The FAA currently ranks Logan as the 7th most delayed airport in the

FIGURE 7-3
1991–1998 Aircraft Operations at Logan



In addition to the Blue Line, the MBTA offers connections to Logan on the CT3 bus route, as well as on several North Shore bus routes originating in downtown. Logan Express, operated by Massport, provides park and ride connections from suburban terminals in Woburn, Braintree, and Framingham. This service attracts over one million passengers per year. Water shuttle service from Rowes Wharf, Quincy, and Hingham is available along with private water taxis from sev-

nation based upon average delay per operation. In 1998, there were 143,000 total hours of aircraft runway and taxiway delays.

Delays at Logan Airport primarily result from three causes.

Two of these causes are due to the number and alignment of Logan's runways.

The airport has five runways, of which four are capable of handling large aircraft. Of these four, only three can be

used concurrently. During times of strong northwest winds, occurring approximately one-third of the time at Logan, the number of operational runways is often reduced to two and sometimes one. This reduction in capacity is one reason for delays. This condition also creates a situation where smaller aircraft are forced to share runways with larger planes. The FAA requires greater distance between large and small aircraft during take-off and landing. Finally, airline over-scheduling at certain peak times presents a third area of potential concern for delays. Although this has not been a problem at Logan in recent years, projections for travel demand at the facility in 2010 would likely result in an inability for the current runways to keep up with demand.

Logan Airport Modernization Projects

In February 1999, Massport filed a Draft Environmental Impact Statement outlining its proposal to eliminate the problem of delays at Logan.

Massport's solution combines improvements to Logan's taxiway system, a new centerfield taxiway and the construction of a new unidirectional runway, known as 14/32. The combination of these improvements is projected to decrease the number of delay hours in 2010 by 105,100 to 160,700 hours, depending on the actual increase in air passengers. The new runway's alignment

itself would eliminate the delays created by strong northwest winds and the need for small

and large aircraft to share runways. The runway would be responsible for 61,000 to 94,000 hours of the delay reductions.

A major environmental issue associated with the proposed Logan Airport runway is the question of added environmental burden placed upon the residents along the flights paths from

Logan. Residents of Boston and its surrounding communities bear the burden of noise pollution from overhead flights.

Massport maintains that the construction and operation of 14/32 would allow for a better distribution of over flights than today. Communities north and south of Logan Airport would benefit from significant reductions. Runway 14/32 would shift approximately 25,000 flights annually from over the land to over the water.

Several projects directed at improving access to Logan have been completed recently, or are in the process of construction or planning. In 1998, the West Garage opened consolidating 3,150 parking spaces under one roof, while an equal number of surface parking spaces were eliminated. Access from this new garage, as well as Central Parking, is being improved through new pedestrian walkways to terminals A, B, C, and E. Terminals B, C, and E are also being improved through renovation projects, while Terminal A is to be completely rebuilt over the next 3 years. The work at Terminal B involves the consolidation of American Airlines' domestic, international, American Eagle, and Business Express services. In order for American's international arrivals to be able to use Terminal B, Massport is building a new satellite Federal Inspection Services Facility (FIS). The only FIS at Logan at this time is at Terminal E. The



new FIS will reduce the need for shuttles transporting passengers transferring between international and domestic flights, as well as the need for aircraft to be towed between terminals. American will also invest in improvements to ticketing areas, baggage handling facilities, concessions, and circulation at Terminal B. Terminal E renovations are scheduled to be complete in 2003 and include the construction of a double-deck access ramp to reduce curbside congestion. Space will also be added for ticketing, customs, and the existing FIS. Delta Airlines will be the primary carrier at the new Terminal A and their gates will be closer together than they are currently at Terminal C. The new terminal will have 25 aircraft boarding positions. Of these, 18 are aircraft gates and 7 are apron parking positions. The current Terminal A has 26 boarding positions, but only 12 of those are aircraft gates. Part of the new facility will also serve as an improved noise barrier between the airport and the Jeffries Point neighborhood of East Boston. As part of Delta's environmental mitigation for the new terminal, the airline's entire ground service fleet will be converted to alternative fuels by 2008. Improved transit access to the airport is also being planned. A rebuilt Airport MBTA station and better connections with South Station via the South Boston Piers Transitway through the Airport Intermodal Transit Connector are two of the current projects that are designed to increase public transportation's share of the Logan air passenger market.

T. F. Green Airport

Located in Warwick, Rhode Island, T.F. Green Airport is the primary airport for the Providence metropolitan area in addition to annually serving over a million passengers from the Boston metropolitan area. Over 200 flights per day pass through Green Airport. Sixteen airlines serve the facility providing flights for all major U.S. carriers except TWA and America West. Nonstop travel is offered between Green and 28 U.S. and Canadian destinations. New York, Chicago, Houston, Toronto, and Washington are among those cities served. These flights carried over 5 million passengers in 2000. The airport is located 60

miles south of downtown Boston. The State of Rhode Island and the MBTA have reached an agreement to extend the Providence commuter rail line south to T.F. Green Airport. As part of the arrangement, Rhode Island will pay for two commuter rail engines to be dedicated to the Providence line. Service on this extension is projected for 2002. Frequencies have already been increased between South Station and downtown Providence and a layover facility is being relocated from Attleboro to Pawtucket, Rhode Island as part of the agreement. Currently, the Rhode Island Public Transit Authority provides local bus service to T.F. Green from a location four blocks from Providence train station. Bonanza Bus Lines currently provides 18 daily trips from South Station to the airport. The bus trip is 90 minutes long. Passengers driving from the Boston metropolitan area primarily use I-95 and have a choice of valet, garage, or long-term lot parking at Green airport. T.F. Green Airport has seen its annual passenger count more than double in the past five years. It is currently one of the fastest growing airports in the nation.

Manchester Airport

Manchester Airport is located 55 miles north of Boston in New Hampshire's largest city. It is the largest airport in New Hampshire and serves a growing segment of the Boston market. Also one of the nation's fastest growing airports in recent years, Manchester has seen its number of daily flights increase to 75 and the number of passengers increase to over 2.8 million in 2000. All major U.S. airlines provide service from Manchester except TWA and America West. Daily nonstop flights are available between Manchester and 14 North American cities including New York, Chicago, Philadelphia, Detroit and Washington. Bus service to Manchester Airport from South Station is provided four times daily by Vermont Transit with travel time of 90 minutes. Both I-93 and Rt. 3 provide access to those driving from the Boston metropolitan area to Manchester. The airport has both a short-term parking garage and long-term lots. Manchester Airport is the third largest cargo airport in New England after

Logan Airport and Bradley Airport in Connecticut. UPS and FedEx are two of the six cargo airlines serving Manchester.

Worcester Airport

Worcester Airport is 48 miles west of Boston in Massachusetts' second largest city. 1.3 million people live within 30 miles of Worcester Airport. Although the airport served 360,000 passengers as recently as the late 1980s, that figure had fallen to 77,000 annual passengers by 1998. The Massachusetts Port Authority has recently taken over the operations of the facility, and hopes to attract more airlines and passengers. There is no direct access to the airport from I-90 or I-290 and local Worcester streets need to be used to reach the facility. There is currently no direct bus access to the airport from Boston, although transfers can be made from downtown Worcester on Worcester Regional Transit Authority local buses. Currently, U.S. Airways Express offers up to four daily flights to Philadelphia, Atlantic Southwest flies twice daily to Atlanta and American Airlines has three flights daily to JFK International Airport. Daily non-stop service to Orlando/Sanford Airport in Florida will be provided by Pan Am beginning in February of 2001. Worcester is projected by Massport to attract from 600,000 to 800,000 passengers by 2010. Projected destinations include Atlanta, Philadelphia, Washington, D.C., New York, Chicago, Newark, Orlando, Pittsburgh and Cincinnati.

Hanscom Field

Hanscom Field is located in the towns of Bedford, Concord, and Lexington, 15 miles northwest of downtown Boston. It has been owned and operated by Massport since 1974. It is the busiest general aviation airport in New England, handling 197,302 operations in 1999. Its business, charter, private and air taxi flights carry approximately 101,000 passengers annually. Only one commercial carrier serves Hanscom. Shuttle America offers ten daily round trips to Trenton, New Jersey Greensboro, North Carolina and Buffalo, New York. In the fall of 2000, Shuttle America

began service between Hanscom and LaGuardia Airport in New York City. The new service consists of five daily roundtrips, with reduced service on the weekends. Massport hopes that this new service will help reduce the demand for shuttle flights out of Logan Airport. Located only one mile from I-95 and Rt. 128, it is easily accessible by car and free parking is provided. Public transportation access is provided on the MBTA's 76 bus route out of Alewife Station.

Pease International Tradeport

Pease International is located in Portsmouth, New Hampshire. Pease is a former U.S. Navy and Air Force base that was converted to a passenger facility in 1991. In addition to charter flights, the Tradeport has recently begun to offer scheduled commercial flights. Currently, the only airline to serve Pease is Pan American Airways, whose headquarters are also at the Tradeport. There is one round trip per day between the Tradeport and Bangor, Maine; Allentown, Pennsylvania; and Orlando/Sanford, Florida. Portsmouth and the Tradeport are located 50 miles north of Boston. Pease is easily accessible by car from I-95. C&J Trailways provides direct bus service from South Station to Pease 14 times per day with a travel time of 90 minutes.

INTERCITY RAIL

Amtrak

Amtrak, the nation's passenger rail system, offers 12 daily departures from South Station in downtown Boston. Amtrak shares the rail facility with the MBTA's commuter rail service and is adjacent to the South Station Red Line subway station and recently constructed intercity bus terminal. Eleven of the departures operate along the Northeast Corridor route which provides direct service to Providence, New Haven, New York City, Philadelphia, Baltimore and Washington, D.C. Service along this corridor makes additional Boston stops at Back Bay Station and the Route 128 Station in Westwood. A total of 550 long-term parking spaces are available at the Route

128 Station for \$10 per day. No long-term dedicated parking is provided at South Station or Back Bay. The other intercity rail destination is to Chicago via Springfield with intermediate stops in Back Bay, Framingham and Worcester.

Annual ridership out of South Station in 1997 was 747,250. Annual ridership for the other stations is as follows: Back Bay 126,100, Route 128 Station 140,600 and Framingham 4,350.

Beginning in January, 2000, Amtrak began a modified, high speed rail service along the Boston to New York corridor. This new train, Acela Regional, initially reduced the travel time from central city to central city to 4 hours. Starting in December of 2000, Amtrak began regular Acela service, with travel times of 3 hours and 27 minutes between Boston and New York. This service between Washington, D.C. and Boston constitutes the only high-speed rail service in the United States. When fully implemented, the train will achieve speeds as high as 160 miles per hour with a travel time from Boston to New York of 3 hours, 5 minutes. Amtrak hopes that its service will rival air traffic and that a portion of the business travel market will shift from air to rail.

Travel times on Acela may be competitive with air because Acela will have stops at South Station, Route 128 and Penn Station in New York City. The business traveler will not have to allocate time at each end of the trip to get to and from the airport but will instead use a convenient downtown or beltway station. Commuting from the central business districts of Boston and New York to the respective airports at each end can add as much as an hour each way to a trip.

An Amtrak intercity rail project currently under construction is the re-institution of service from Boston (North Station) to Portland, Maine. Other stations served by this route include Woburn, Andover, Haverhill, Exeter, Dover, and Durham, New Hampshire; and Wells, Saco, and Old Orchard Beach, Maine. This service will be operational in April 2001 with travel times between Boston and Portland of 2 hours, 30 minutes.

In addition to the Acela service along the Northeast Corridor, two additional New England rail corridors have been designated by DOT as high-speed rail corridors. The first is the new service between Boston and Portland, Maine. The second corridor runs from Boston (North Station) to Burlington, Vermont. This line would serve Lowell, Nashua, Manchester and Concord, New Hampshire; and Montpelier, Vermont. The line could potentially extend through St. Albans, Vermont to Montreal, Quebec.

A proposal for the connection of North Station and South Station is under study by the MBTA.

This would provide a connection for Amtrak service as well as MBTA commuter rail.



Acela train

Commuter Rail

The MBTA's commuter rail system provides service to other New England cities, although these trips are primarily scheduled to coincide with commuting patterns

into Boston. The largest cities served by the commuter rail system are Providence and Worcester from South Station, and Lowell from North Station. The MBTA recently participated in efforts by the New Hampshire Department of Transportation to extend commuter rail service to Nashua, New Hampshire and potentially Manchester, New Hampshire. The project to extend

the commuter rail service 11 miles from Lowell to Nashua has received a \$16 million federal earmark in FY 2000 FTA New Starts funding, of which \$1 million is now being used to contract for preliminary engineering, design and permitting work. An extension of the Haverhill commuter rail line to Plaistow, New Hampshire is being pursued by that state.

INTERCITY BUS

The vast majority of intercity bus trips that serve the Boston metropolitan area use the South Station bus terminal as their Boston passenger facility. The terminal is adjacent to the South Station rail terminal and subway station. On an average day, 12,000 passengers pass through the bus terminal. Although some of this travel is suburban commuter trips, most of it is longer intercity travel. This market is served by several companies with Greyhound, Peter Pan and Bonanza having the largest number of daily arrivals and departures. Between Greyhound and Peter Pan there are departures to New York City every 15 minutes throughout most of the day. Direct service to most major cities and attractions within New England are available, as is service to Montreal and Toronto. Since its completion in 1995, the number of buses using the facility has increased to the point where consideration is being given to adding an additional level.

AUTOMOBILE

By far the largest share of intercity travel is by automobile. Nationally, almost 80% of all intercity passenger miles are traveled by use of the automobile. The automobile offers the convenience of traveling at a driver's discretion, the

immediate incremental cost of travel is relatively low and the driver has more freedom to divert from a schedule. These are all the same reasons that a large percentage of personal local trips are made by automobile.

I-95

Interstate 95 provides the only direct highway connection to New York City from the Boston metropolitan area. Between Boston and New York, I-95 also serves Providence, Rhode Island

and New Haven, Connecticut. I-95 continues south through the corridor to serve Philadelphia, Baltimore and Washington, D.C.

Although I-95 does not pass directly through Boston, access to the highway is provided on Interstates 93 and 90. The distance to New York City from downtown Boston on this route

is 229 miles. To the north of Boston, I-95 serves Portland, Maine.

I-90 (Massachusetts Turnpike)

The Massachusetts Turnpike provides an alternate route to New York City and the rest of the Northeast Corridor from Boston. The primary variation of this route involves taking the Turnpike to Sturbridge, and then using Interstates 84 and 91 to connect with I-95 in southern Connecticut. It is 225 miles to New York City via this route. The Turnpike charges a \$2.15 toll to travel from Boston to Sturbridge. The Turnpike is also the fastest route to Worcester and Springfield.

The following chart shows a comparison of ways to travel between Boston and New York City. The costs and distances are for one-way travel. The largest percentage of trips between the two city pairs is by automobile. One reason is the conven-



ience of travel on demand afforded by a personal automobile and the fact that most of the cost of automobile use is a fixed cost already absorbed by the consumer with the purchase and upkeep of the vehicle.

FIGURE 7-4
Intercity Travel between Boston and New York by Mode

Mode	Cost ¹	Frequency ²	Travel Time ³
Auto	\$93	N/A	4 Hours
Air	\$65	30 Minutes	1 Hour
Bus	\$33	15 Minutes	4 Hours
Rail	\$50	90 Minutes	4 Hours

¹ Cost is one way based on the purchase of a round trip ticket. For automobile travel, the price was determined by using Federal Highway Administration estimates on the cost of owning and operating automobiles per mile (41¢ per mile), multiplying this figure by 212 miles, and adding current toll expenses.

² Frequency is based on weekday daytime departures. In the case of air and bus travel, the combination of two or more private companies' timetables is implied in the frequency level.

³ Travel time is one-way. For automobiles, it is assumed that travel takes place at the posted speed limit. Travel time for air, bus and rail is taken from published timetables. All times are based on downtown to downtown travel, with the exception of air, which is airport to airport.

CONCLUSION

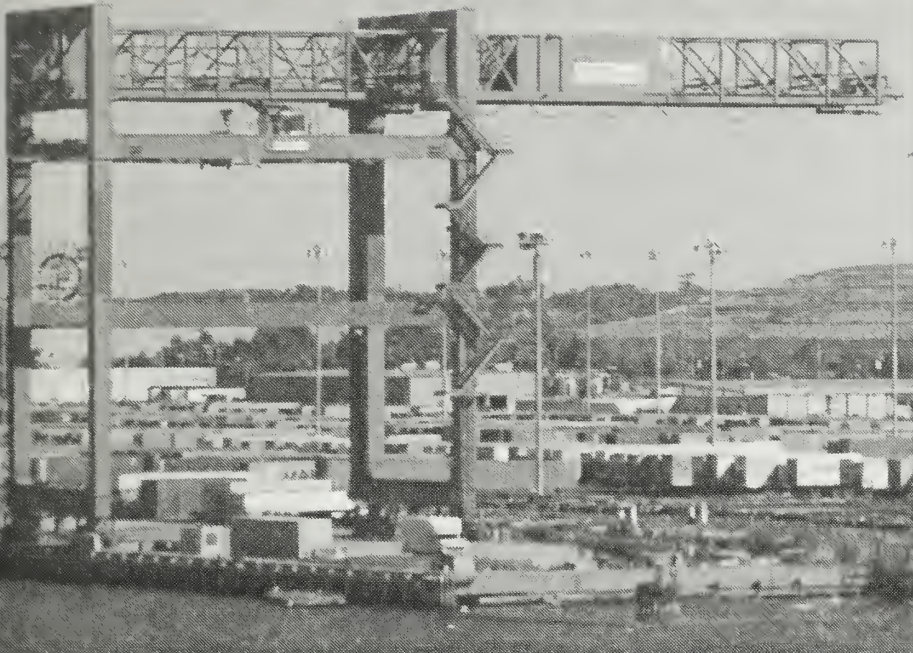
As the Boston MPO plans for the future transportation needs of the region, the identification of strategies that facilitate travel throughout New England and the Northeast Corridor becomes a primary focus. While the density of population, employment and attractions throughout this part of the country represent one of the region's principal strengths, they also present a significant planning challenge. While other regions have more flexibility and space for roadway and airport expansion, the Boston region faces significant and often insurmountable physical obstacles preventing the expansion of infrastructure. And all regions must deal with significant financial constraints

Over the next twenty years and beyond, the Boston MPO must work in concert with Massachusetts state agencies and local representatives, as well as the states of Connecticut, Maine, New Hampshire, Rhode Island and Vermont, to develop transportation strategies that address regional needs despite these constraints. As the demand for air travel continues to grow, the MPO must continue to promote regional solutions. Whether these solutions involve more efficient use of existing facilities at Worcester and Hanscom, or improved partnerships with airports in Rhode Island and New Hampshire, the end result will be Logan Airport's ability to continue as the gateway and transportation hub of the region. By building on the success of Amtrak's Acela service through the promotion of additional high-speed rail corridors to Vermont and Maine, the Boston MPO can help to provide the region's travelers with a variety of options for intercity trips. The exploration of commuter rail as a means to solve congestion problems between Boston and cities in southern New Hampshire, southeastern Massachusetts, and T.F. Green Airport will further broaden the spectrum of choices for the region's travelers. Through efficient management of our existing facilities and by targeting new infrastructure to provide more choice the Boston MPO can meet regional transportation needs despite the physical and financial challenges it must face.

CHAPTER

8

FREIGHT TRANSPORTATION



A key component of a healthy, vibrant economy for the Boston and New England region is the ability to efficiently move goods and freight within the region. For the most part, the movement of freight is carried out by the private sector using both public and private infrastructure. The main modes of freight movement within the region are truck, rail, water and air.

The efficient movement of freight in the region requires an infrastructure that allows for the smooth transfer of goods to its final destination. Impediments to movement increase the cost of delivery of goods and places a drag on the economy of the region. The two major determinates of how goods are shipped are price of transportation and travel time. The choice of different modes (truck, rail, water or air) best able to deliver goods within a required timeframe for a reasonable price is made by private vendors on a daily basis.

The freight market within Boston and New England is compact in nature. Approximately 95% of all freight shipped through the Port of Boston has a final destination of 75 miles or less. New York City to the south serves as the primary freight distribution center for the Eastern United States. To the north, the deep-water port of Halifax with its excellent rail network provides the Canadian provinces and the United States MidWest with good intermodal freight service. Because of these factors, the truck is the predominant mode of freight movement for the Boston and New England regions.

The rest of this chapter provides a brief overview of each of the modes of travel and discusses the competitive advantages and disadvantages that each faces within the Boston region. There is also a discussion about the major intermodal terminals within the region.

TRUCK

The trucking industry is a privately operated and highly-competitive industry that depends upon the state and local authorities to maintain a safe and efficient highway network. The United States economy depends on the trucking industry for a majority of the shipments of goods to factories, stores and households. This includes both the long-distance movement of goods to and from distribution centers as well as the local deliveries of express packages and household goods.

The trucking industry is composed of several major types of operators. These include private fleets owned by businesses or industries to support their own needs, for-hire truckload carriers (TL) that operate over a long distance, and less-than-truckload (LTL) operators who operate regionally and carry smaller loads than TL firms. Each of these types of carriers depends on having a roadway network that meets its needs. Of major concerns are

- having roadways maintained in good condition,
- having intersections that are designed to handle truck turns and movements,
- maintaining bridges that can structurally handle the required weight of a fully-loaded truck, and
- having an interstate and arterial highway network that allows for efficient connectivity to major freight destinations.

Truck freight terminals in the Boston region are concentrated at intersections of major arterial

highways. I-95/Route 128 and I-495 have the highest concentration of terminals.

A major problem facing the trucking industry in the Boston region is the lack of a coordinated truck route policy. Because of the nature of how street patterns developed within the Boston region

over the past 350 years, it is often common to have truck routes along heavily-populated residential corridors. This causes a conflict between resident's desire for a quiet and safe streetscape and the trucking industries desire for a reasonably direct route between origin and destination.

Under Massachusetts law, a community must gain permission from the MassHighway before

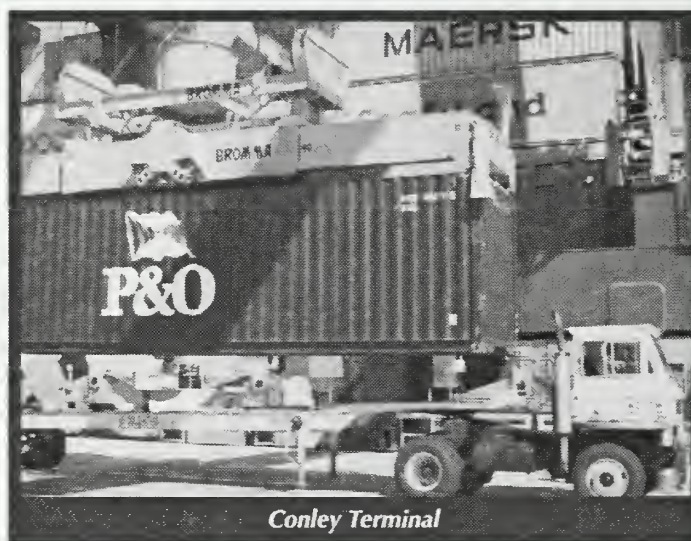
restricting truck traffic along streets within the community.

The Boston MPO is currently conducting a study of truck routes in Cambridge, Boston, Somerville, Watertown and Belmont. The truck study is expected to be completed during Spring, 2001 and findings and recommendations from that study will be considered in the update of the next Transportation Plan.

RAIL

The railroad industry in North America has been undergoing a major consolidation of rail companies over the past three years. In the East, Conrail was purchased by the two other Class 1 railroads serving the Eastern United States- CSX and Norfolk Southern. As of June 1999, all of the freight rail lines and associated intermodal facilities previously owned by Conrail in Massachusetts became the property of CSX.

The major products shipped by rail within Massachusetts include automobiles, containers (with and without chassis), bulk products and chemi-



cals. Freight can either be delivered directly to a customer by railside-access, as is the case for industrial users, or delivered to an intermodal freight yard. At this point the truck is the main form of inter-modal exchange. Because the Port of Boston has no direct rail access, any containers destined for the port by rail have to be transported from a rail intermodal terminal by truck.

Over the past two decades, a major change in the use of rail occurred with the institution of transporting a truck-container car on rail flatbeds, either with or without a chassis. The movement of containers by rail is usually only efficient over long distances. Over short distances, the most efficient movement of containers is over the road. The trend of larger over-the-road shipments to rail has resulted in a closer linking between the rail and truck industry. A more recent improvement is the institution of double-stack rail carriers. This train configuration allows for two container cars to be stacked on one specially designed flatcar. Double-stack ship-

ments by railroads has increased the competitive advantage for rail shipments. But double-stack rail requires a higher bridge clearance. Even one

bridge obstacle between the origin and destination will prevent double-stack rail delivery.

The main problem facing railroads in Eastern Massachusetts is the lack of highway bridge clearance heights along existing freight railroad right-of-ways. The preferred national standard for double-stack

clearance is 22' 6" and at a minimum, 20' 8". This would allow for two 9' 6" containers stacked on top of each other. Presently, double-stack rail service is not possible east of Framingham along the CSX mainline corridor or southeast of Ayer on the Guilford line.

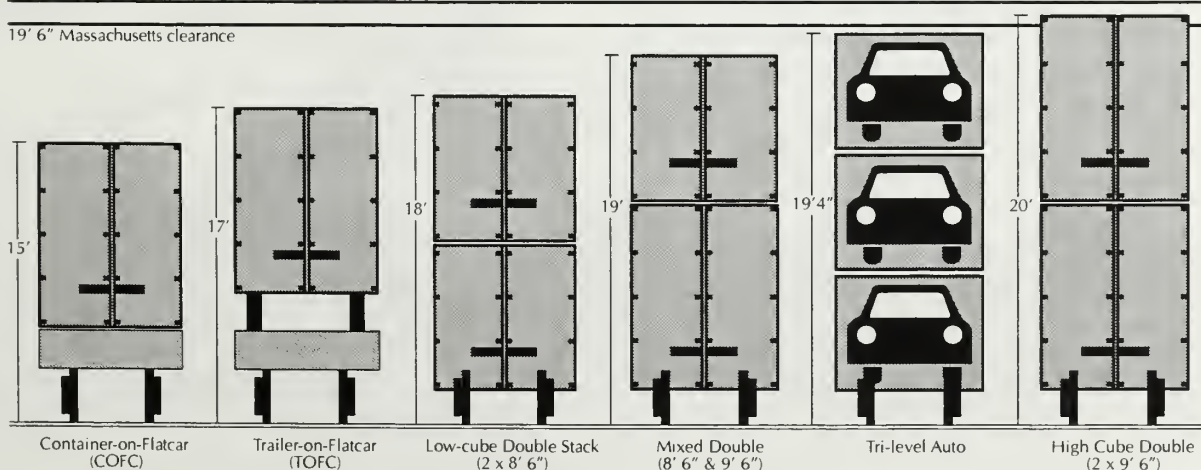
This lack of clearance places CSX's Beacon Yards and the Port of Boston at a competitive disadvantage relative to other freight rail yards or East Coast ports. This increases the cost of shipping goods within the Boston region and reduces



FIGURE 8-1
Rail Car Clearances

22' 6" National double stack standard

19' 6" Massachusetts clearance



the ability of these intermodal centers to compete on the basis of price.

The State of Rhode Island is working on upgrading the P&W rail line from the Port of Quonset to Worcester to allow for double stack rail. This integration into the CSX national system would put Beacon Yards at a disadvantage.

Providing double stack rail capability to the Port of Boston faces two main hurdles. The first is the cost associated with redesigning and building the low-height bridges along the CSX mainline from Worcester to the Boston waterfront. In 1996, the state and Conrail proposed a \$200 million rehabilitation program to rebuild the bridges to allow for double stack but that program was put on hold during the sale of Conrail to CSX and Norfolk Southern. Bringing double-stack rail to Conley Terminal is problematic because of the the rail clearance heights under the Prudential Center tunnel.

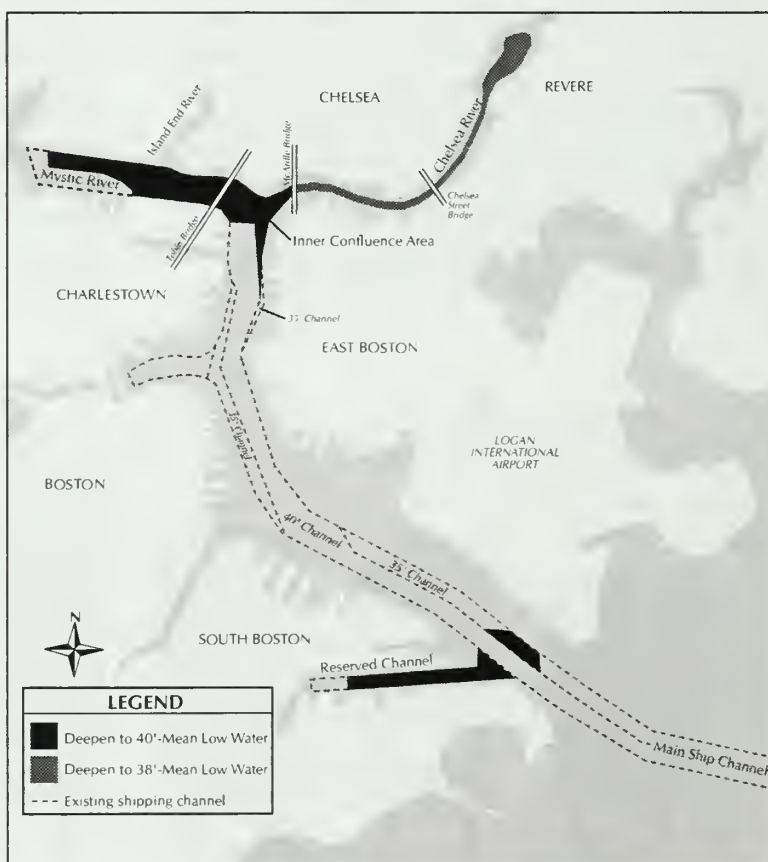
The second hurdle is that direct on-dock rail access does not exist to Conley Terminal in South Boston, it extends to Massport property adjacent to the Reserve Channel. All container traffic must be drayed by truck the five miles to Beacon Yards and then put on trains. This truck to rail segment puts the port at a competitive cost disadvantage. Currently single-stack rail access

Beacon Yards, Boston: This intermodal rail terminal is located within one mile of the Allston toll booths of the MassPike and serves as the major freight transfer point between rail and truck for the Boston region. It also serves as a transfer point for containers that are drayed by truck from Conley Terminal in the Port of Boston. In 1996, approximately 100,000 railcar and intermodal shipments to and from Boston were made with intermodal containers accounting for 70% of this volume. CSX operates eight intermodal freight trains and two general

merchandise freight trains daily between Beacon Yards and Selkirk, New York.

In 2000, the Massachusetts Turnpike Authority sold a portion of the land adjacent to the Beacon Yards to Harvard University. Over time this land currently used for freight and vehicle storage will probably be converted into academic use further constraining the land available for a true intermodal freight facility within the city of Boston. The more constraints placed on Beacon Yards, the more difficult it is for the Port of Boston to efficiently distribute freight.

Ayer/Devens Tradeport: This intermodal rail terminal is located just outside of the Boston MPO border in the town of Ayer. Guilford/Springfield Terminal Railway operates three separate intermodal facilities within the Ayer area. This includes an Ayer Automobile facility, the Devens Tradeport and the Ayer Warehouse facility. Guilford completed work to increase the rail clearance of the Hoosac Tunnel in Western Massachusetts



Dredge Work Completed in Boston Harbor

to allow for tri-level auto carriers to its Ayer facility. But this clearance is not enough to allow high-cube double stack containers.

Guilford/Springfield Terminal Railway and Norfolk Southern Railroad have an operating agreement which opens up the northern part of Massachusetts to freight rail on the NS national system.

WATER

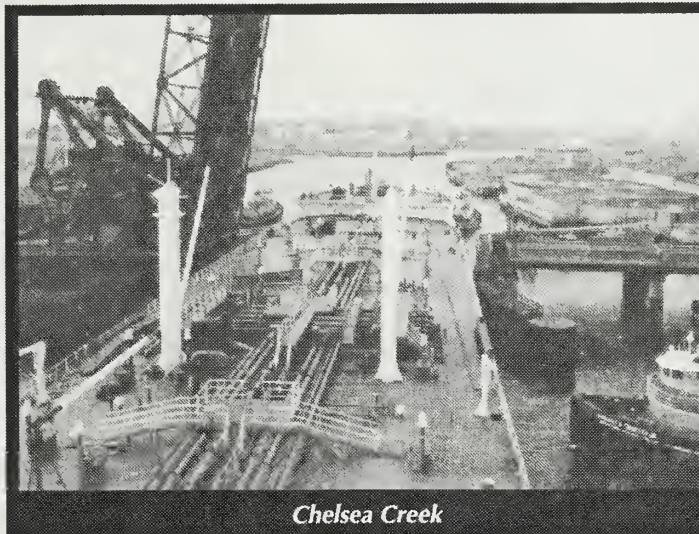
The major categories of freight moved by water include refined

petroleum products, liquid natural gas, dry bulk commodities such as coal, sand or scrap metal, containers and automobiles. Foreign trade is increasing as more countries of the world join the global marketplace. Increasingly, goods are shipped from these countries by water in containers and then off-loaded on rail or truck for delivery to its final destination.

Major trade routes from Boston include barge traffic from the Port of New York/New Jersey and scheduled container ship service from Europe and Asia.

The trend among major container cargo shippers is to use larger and larger container ships. A Post-Panamax ship (one so large it is not capable of

navigating the Panama Canal) can carry up to 8,000 TEUs. This trend to larger ships also means that these super carriers will only be calling at a few major ports around the world.



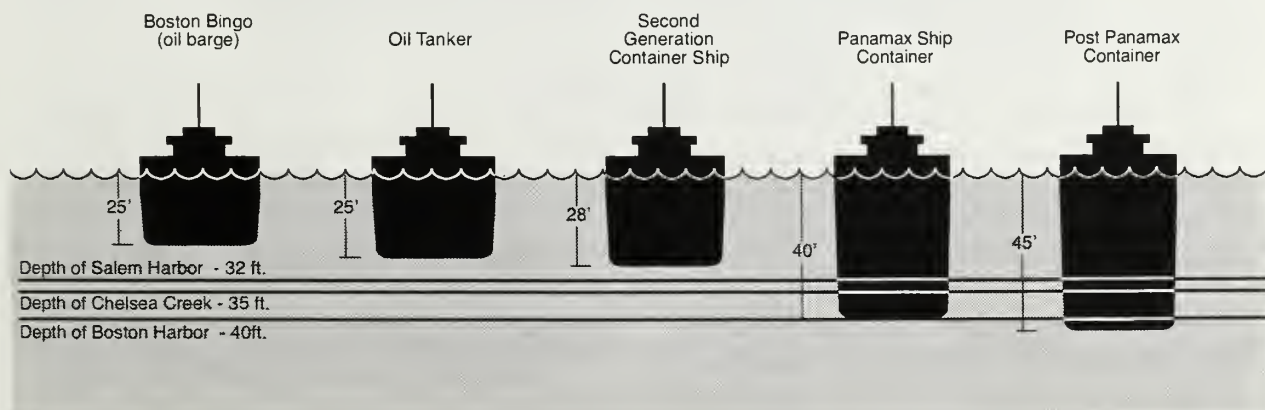
Chelsea Creek

The competition faced by Boston being between New York City and Halifax, Canada is formidable. New York, which also faces problems with the depth of its harbor, is the largest metropolitan area in terms of population in North American and a major transportation hub. Halifax to the north has a natural deep

water port with direct dock rail terminals with connections to the Canadian National railroad network. It is also one day closer to the ports of Northern Europe. It is able to handle Post-Panamax ships.

The ports of the Boston region have played a key role in the economic development of New England since the 1600's. The main ports of the Boston region include Gloucester, Salem and Boston.

Port of Boston: Boston is the leading port in New England, serving as the major point of entry for petroleum products such as heating oil and gasoline, containers and bulk products. The port has a natural deep water harbor and anchorage



Port of Boston Cargo Activity	1999	1998
Total Port of Boston Cargo Metric Tons	17,065,113	15,986,405
Containerized Cargo		
Import Tons	935,450	890,228
Export Tons	382,502	338,829
Total Tons	1,317,952	1,229,057
Container TEUs	158,051	150,477
Container Vessels	304	305
Bulk Cargo Vessels (in Metric Tons)		
Automobiles	106,506	84,992
Petroleum Products (Estimated)	12,406,296	12,660,404
Salt	535,707	365,840
Liquefied Natural Gas	1,924,972	793,237
Gypsum	186,503	184,695
Cement	249,324	193,104
Other (Fish,Veg,Oil)	98,077	73,033
Total Bulk Imports	15,507,385	14,355,305
Bulk Cargo Exports (in Metric Tons)		
Scrap Metal	238,075	401,329
Other	1701	714
Total Bulk Exports	239,776	402,043
Total Bulk Cargo	15,747,161	14,757,348
Bulk Cargo Vessels/Dock Arrivals	972	1,133
Automobiles (Vehicles)	80,540	64,271
Auto Vessels	84	73

area with direct access to the ocean. The port handles a wide variety of waterborne commerce. Petroleum and petroleum products represent 88% of the volume by weight handled at the port. Massport and the U.S. Army Corps of Engineers recently completed a dredging of the main navigational channel as well as Conley Terminal and the Inner Confluence area. As ships increase in size, the depth of the port and length of time the terminal is from the ocean are becoming increasingly important.

In 2000, Massport and the U.S. Army Corps of Engineers completed a dredging project for Boston Harbor. The main shipping channel was

widened and dredged to a consistent 40 foot depth and the Chelsea River and Inner Confluence area were dredged to at least 38 feet. The map on page 102 shows the extent of the work completed.

Because the port is facing increasing pressures from other ports along the East Coast, Massport reorganized the water port facilities under its control. Massport's Marine Terminal Optimization Plan (MTOP) consolidated all container traffic in the port at Conley Terminal to provide more efficient handling of containers and to reduce the travel time for ships calling on the

Port of Boston. The accompanying chart details the port activity for the years 1998 and 1999.

Oil terminals: oil terminal facilities in Boston Harbor are located in South Boston, Chelsea Creek and Mystic River. A constraint to the efficient delivery of oil is the navigational constraints in the inner confluence area and along the Chelsea Creek. The Chelsea Creek drawbridge spanning Chelsea Creek does not provide a standard amount of width to allow modern tankers to transverse the waterway. Because of this, large oil tankers have to lighten their loads onto smaller barges in the harbor for delivery up the creek. This requires extra time and labor and increases the cost of delivering oil to the Boston area. The Chelsea Creek also has sharp bends and a lack of width for ships to both berth and pass along some portions. These constraints add to the time of delivery and therefore the ultimate cost of transportation.

Conley Terminal is a fully dedicated container terminal located in South Boston. The terminal has 1,950 feet of berthing space with low-profile Post-Panamax container handling cranes. The intermodal terminal has 101 acres of land and serves as the largest container terminal in New England. Before 1998, container traffic was split between Conley Terminal and Moran Terminal. When Moran Terminal was used for container traffic, large container ships had to wait for certain tides to be able to sail under the Tobin Bridge.

Charlestown: Moran Terminal is located in Charlestown. It has a depth of 40 feet with 50 acres of paved open storage space. As part of the MTOP, Moran as well as Mystic Pier 1 have become the Autoport for

Boston. Moran handles automobile imports for a variety of automakers including Subaru and Volkswagen. The facility off-loads cars and prepares them for delivery to dealers across New England. The autos are transported from Moran by truck auto-carriers. The lack of clearance for tri-level auto carriers from Ayer to Moran places the Autoport at a competitive disadvantage to the port of Davisville, RI.

Also located in Charlestown is the Massport Mystic Pier Terminal 48, which handles dry bulk cargo (salt). Adjacent is the privately-owned U.S. Gypsum terminal.

Salem Harbor: Salem Harbor is a Designated Port Area (DPA), has a main channel depth of 32 feet. The main commodities handled at the port are coal and fuel oil. The deepwater portion of the harbor serves a power generating plant and as an oil storage facility. Almost 90% of the shipments handled at the harbor are domestic.

Gloucester Harbor: Gloucester is home to a large commercial fishing fleet and serves as a major fish-handling port with the largest cold storage facilities in the United States. It also serves as a port for fuel oil.

AIR

Freight moved by air usually contains at least one of the following characteristics—time sensitive, high value-to-weight ratio, and perishable. Air freight cargo is handled either as belly freight in the cargo hold of commercial passenger aircraft or by dedicated freight carriers.

Because of the reliance on regularly scheduled commercial passenger service, major air freight

TABLE 8-1
Cargo Volumes (in tons) at Logan Airport, 1991–1998

		Express/ Small Packages	Freight	USPS Mail	Total
Charlestown: Moran Terminal is located in Charlestown. It has a depth of 40 feet with 50 acres of paved open storage space. As part of the MTOP, Moran as well as Mystic Pier 1 have become the Autoport for	1991	135,147	189,824	58,321	383,292
	1993	167,866	180,978	69,029	417,873
	1995	207,733	157,018	70,157	434,907
	1997	236,133	171,194	79,757	487,085
	1998	236,054	165,867	83,461	485,382

Note: there has been a 27% growth in freight volume from 1991 to 1998

carriers are almost always located at large commercial passenger airports.

The only major intermodal movement between air freight and its final destination in the Boston region is by truck. Logan Airport serves as the only air freight terminal in the Boston region. The opening of the Ted Williams Tunnel to commercial traffic in 1996 has improved truck access to the airport from the South Boston and I-93 area.

Logan International Airport serves as the primary air cargo facility for the Boston region. In 1998, it ranked 19th in the US and 36th in the world in terms of cargo handled. Dedicated freight carriers located at Logan Airport include Federal Express, Airborne, DHL and UPS. Cargo volume is split among express/small packages, freight and USPS mail. Table 8-1 shows the freight volumes for the past decade. As can be seen from the chart, the major area of growth is in the express and small packages category. In 1998, there were approximately 11,000 freight-only aircraft operations at

Logan, about five percent of total airport flight operations. Most freight-only flights occur outside of the peak congestion periods for Logan Airport, so these freight-only flights do not contribute to the delay problems at Logan. But a majority of these flights occur at night, when noise impacts are more perceptible and disturbing to residents within the flight paths.

The two main cargo handling facilities at Logan Airport are the North Cargo Area, located along Route 1A-north of the Airport MBTA station, and the Bird Island Flats/South Cargo Area, located south of Terminal B and bordering the Boston Harbor. All freight movement to and from the airport occurs by truck. There is no freight rail access to Logan Airport, and no provisions for future rail access as a rail travel market would be unlikely to develop for air freight commodities. Massport is exploring the concept of building a truck haul road from the North Cargo Area along the abandoned Conrail right-of-way.

CONCLUSION

The Boston region is facing a series of growing problems in the movement of freight. An aging roadway, water and rail infrastructure places constraints on the options available to private shippers and companies who must look to move their goods by the most economical way available to them. The constraints imposed by low-height bridges restricts railroad use of double-stack container cars, this is at a time where railroads across the country are moving to double and sometimes triple stack containers. The compact nature and geographic location of Boston and New England means that most shipments are short-haul versus long-haul. The depth of the harbor may not be able to handle the mega-container ships of the future. The oil and gas storage facilities are located along waterways that are not conducive to the large oil tankers of the 21st Century.

For the foreseeable future, the major mode of freight movement within the Boston region will remain the truck. But rail, water and air have an important part to play in the safe and efficient delivery of the region's goods.



9

FORECAST OF 1995 BASE CASE AND 2025 BUILD SCENARIOS

During the development of the new regional Transportation Plan, it was important to be able to conceptualize the region's transportation needs over the next 25 years. Land use patterns, employment and population growth, and trends in travel patterns are all likely to create different demands on the region's transportation system. In order to provide the public and decision-makers with a tool for estimating future demands on the system, the Central Transportation Planning Staff maintains a regional travel-demand forecast model. The model also provides a means by which potential projects can be assessed in terms of their benefits in areas of pollution control, travel times, and congestion reduction.

TRAVEL DEMAND MODEL CHARACTERISTICS

The travel model set that is used for the 2000–2025 Transportation Plan simulates existing travel conditions and forecasts future year travel on the entire Eastern Massachusetts transit and highway system. In order to capture a more accurate picture of the travel demands for the region, an area larger than the Boston MPO region is used. The Eastern Massachusetts Regional Planning Project (EMRPP) area is used. The EMRPP region includes an additional 63 communities outside of the 101-municipality Boston MPO, including communities east of Worcester, north to the New Hampshire border and to the south including portions of Bristol and Plymouth counties.

The model contains all MBTA rail and bus lines, all private express bus carriers, all express highways and principle arterials, and many minor arterials and local roadways within the EMRPP. The region is subdivided into several hundred traffic analysis zones. The model set simulates the modes and routes of trips from every zone to every other zone. This simulation is the result of several inputs, the most important of which are population, employment levels, auto ownership, transit fares and automobile costs and highway and transit levels of service. These inputs are updated on a regular basis to ensure the reliability of the model forecasts. The model set, which is of the same type as those used in most other large urban

[illegible]

areas in North America, also incorporates many new procedures including the ability to measure non-motorized trips.

The travel model analysis for the 2000–2025 Transportation Plan consists of several steps. First, an existing conditions network was tested to simulate recent (1995) travel conditions. Then a future no-build alternative was coded and run using the travel model. The no-build alternative is the scenario that assumes that only those improvements noted in the No-Build section of Appendix A will be made between 1995 and the year 2025. It provides a baseline against which the predicted effects of potential future investments in the transportation system will be measured.

The forecast for the no-build uses the 2025 demographic data developed by MAPC.

Next, a new set of projects was added to the no-build. This alternative was coded and run using the model. Using the no-build analysis as a point of reference, the statistics help to measure the effectiveness of each future action alternative. Several important travel statistics will be summarized for each of these model runs. Examples of these statistics are:

- Total vehicle miles of travel (VMT) and vehicle hours of travel (VHT), made by all vehicles on a typical weekday in the entire Eastern Massachusetts region and subregions
- Average speed of highway traffic in the region
- Amount of air pollution produced by the automobile, and transit vehicles
- Total number of daily trips made by auto and transit in the region
- Average daily transit ridership by transit mode (bus, subway, commuter rail, etc.)
- Average mode split (percentage of people traveling by each of the travel modes)
- Average trip length for transit and auto trips

BASE CASE, NO-BUILD AND BUILD ASSUMPTIONS

The travel demand model uses the year 1995 as a starting point for model analysis. This is the latest year that the MPO has a depth of reliable data for model inputs. Only those projects that are “regionally significant” as defined by the federal government are included for analysis. Those projects are regional in nature, add capacity and can have air quality impacts as measured by the travel demand model. The set of projects included in the travel model for this Transportation Plan are grouped into three categories.

1995 Base Case scenario

The 1995 Base Case consists of those major roadway and transit projects that were built and opened for public use by December 31, 1995. Those project’s attributes were coded into the model to serve as the base starting point for analysis.

1995 Base Case Scenario projects

Urban Ring bus service
Worcester commuter rail, partial service
Additional parking spaces
South Station Transportation Center
Route 53, Phase 1 (Hanover)
HOV lane on I-93 (Mystic Avenue)
HOV lane on the Southeast Expressway
Ted Williams Tunnel
South Boston Bypass Road

2025 No-build scenario

The 2025 No-build scenario consists of those projects that have opened for public use after January 1, 1996, are under construction and will open in the near future or have been advertised for construction and are awaiting for construction to start. Only those projects that the MPO felt were far enough along in the programming and construction process were included in this list.

2025 No-Build Scenario

Commuter boat service in the Inner Harbor
Newburyport commuter rail service
Old Colony commuter rail (two lines)
Additional parking spaces
Beverly Salem bridge
Blue Hill Avenue signal coordination
Brighton Avenue signal coordination
Route 139 (Marshfield)
Route 20 (Marlborough)
Route 128 Amtrak station
Central Artery
North Station improvements
Blue Line modernization
Worcester commuter rail, full service
Silver Line-Transitway, Phase 1
I-495 Interchange (Marlborough/Southborough)
I-93 Induriplex Interchange (Woburn)
Quincy Center Concourse, Phase 1
Route 62 and Middlesex Turnpike
Route 9 Wellesley
Amtrak Northeast Corridor Electrification
Marrett Road signal coordination
Route 138 (Canton)
Induriplex Intermodal Center (Woburn)
Route 38 (Wilmington)

2025 Build Scenario

Silver Line-Washington Street, Section C
Route 128 Additional Lanes
Airport Intermodal Transit Connector
Massachusetts Avenue Lafayette Square
(Cambridge)
Route 1 and associated improvements
Telecom City Roadways
Induriplex Intermodal Center Phase 2
Route 20, Segment 2 & 3
Route 140 (Franklin)
Route 3 North
Cambridgeport Roadway
Route 53 (Hanover)
Bridge Street Bypass Road (Salem)
Crosby Drive
Middlesex Turnpike (Bedford)
Route 2/Crosby's Corner
Dedham Street I-95 Southbound Ramp
Needham Street (Newton-Needham)
Greenbush commuter rail extension
Arborway Green Line service
Green Line extension to Medford Hillside
Red Line/Blue Line connector
Silver Line-Transitway 2, Section B
Russia Wharf ferry terminal

2025 Build scenario

The 2025 build scenario consists of those new regionally significant projects endorsed by the Boston MPO for inclusion into the 2000-2025 Transportation Plan.

MODEL RESULTS AND INTERPRETATIONS

An analysis of the model results comparing build and no-build scenarios must be made with an understanding of the scope of their meaning. All of the differences between the build and no-build, are dwarfed by the changes projected to occur between now and 2025 in the region's travel measures levels. However, the differences described by the model resulting from the choice of build or no-build are well within what would be expected and they do represent some very real benefits that would accrue as a result of the trans-

portation investments contemplated. It is very difficult, looking at an entire transportation system that is forecast to contain 17 million trips, to perceive much change in many of the performance indicators – particularly those pertaining to the highway system. Certainly, there would be much larger changes in performance evident if these statistics were examined on a facility or corridor basis, and that is precisely where the benefits are supposed to be apparent. After all, transportation investments are usually made to address a transportation need in a particular corridor or other restricted geographic area. Understanding the regional impacts of a package of investments is still informative, however, and the impacts forecasted by the model follow.

INCREASE IN TRIPS

As indicated in Chapter 2, the new 2025 Trends Extended forecast projects significant growth in

the number of employees and residents in the EMRPP region. As indicated in Table 9-1, this growth (23% for households and 31% for employment in 2025) is expected to be greatest in the center of the region (Downtown Boston) and in the outer portions (Rings 3 and 4) of the region. In addition, as indicated in Table 9-2, the average household size and number of workers per household are expected to fall, while the average household income is expected to rise slightly. The Auto Ownership Model indicates that this combination of socioeconomic changes will lead to the overall average number of vehicles per household falling slightly.

This growth leads to substantial increases in the number of trips produced by and attracted to the region on an average weekday. As indicated in Table 9-3, the number of trips is expected to increase by 25% in 2025. The biggest increases are expected in Downtown Boston (Ring 0), the outer portion of the EMRPP region (Ring 4), external zones (areas just outside of the region) and non-home-based trips (where the traveler's residence is not the origin or destination).

Table 9-4 presents a breakdown of trip growth by mode and time period. Total intraregional person trips within the model are projected to increase from 14.2 million per day in 1995 to 17.4 million in 2025. As indicated in Table 9-4, transit and walk trips are expected to grow at a faster rate than auto trips. Transit trips increase from 776,000 in 1995 to 1.13 million for 2025 no-build and 1.16 million for 2025 build. These increases represent growth of 45.6% and 49.8%, respectively. Trips made by auto show a lower proportional increase from 11.2 million in 1995 to 13.2 million (or approximately 18%) for both the 2025 no-build and build scenarios. Walk trips are projected to increase from 2.2 million in 1995 to 3 million for 2025 no-build (a 35.6% increase) and 2.9 million for 2025 build (a 35.1% increase).

CHANGES IN TRANSIT RIDERSHIP

In order to determine the true level of transit demand given the underlying population and employment projections, the transit ridership

forecasts presented by the regional travel forecasting model are not constrained by transit service capacity. As a result, the ridership growth projected by the model will in a number of cases exceed the passenger capacity of the busses and trains in service.

The above section notes that transit system linked trips would increase by more than 30,000 in the build scenario versus no-build. That represents a benefit to the region's travelers, particularly when considering the amount of transit investment in the no-build that would already have captured additional transit riders even before these additional build scenario investments were made.

Another sign of the success of these investments is the mode share for transit. As indicated in Table 9-5, the increase in transit trips yield an increase in transit mode share from 5.5% in 1995 to 6.5% for 2025 no-build, and 6.7% for 2025 build. This increase of .2% for the build scenario versus the no-build at the system level is significant. Note that about two-thirds of the new transit riders would be attracted from the automobile mode, while one-third are shifted from the walk mode. The Greenbush line is the most significant of the various build scenario projects that would noticeably attract riders from the automobile mode. The shift from walk mode is due primarily to two transit projects. One of these is the Blue/Red line connector which is designed to obviate both excessive transferring as well as walking between stations for travelers using both lines to accomplish a trip. The Silver Line project would also obviate many walk trips between the financial district and the Fan Piers area. The increase in transit ridership does not affect each transit mode equally. With the largest growth expected in the outer portions of the region and the Downtown Boston area, commuter rail ridership growth is forecasted to be substantial (154% for 2025 no-build and 171% for 2025 build). Rapid transit ridership growth is also expected to be large (50% for 2025 no-build and 53% for 2025 build). Among the rapid transit lines, the largest growth in ridership is expected on the Red Line (as indicated in Table 9-6). All the other lines are also projected to grow by at a significant

rate. This growth in rapid transit ridership may also exceed available capacity.

The forecast transit ridership results derived from the model are not constrained by parking lot capacities. For the 2025 Build scenario, transit station parking demand exceeds parking supply by as many as 20,000 spaces. This is an issue that the MPO will need to address in the refinement of the Transportation Plan.

In addition, although not reflected in these statistics, the added transit capacity in the 2025 build scenario would have the added benefit of helping to serve what is projected to be excess transit demand (that exceeding available supply) in the 2025 no-build scenario. The quality of transit ride is also affected by the investments made in the build scenario. The transfer rate for transit trips would decrease slightly. This represents a benefit for transit riders since transferring is perceived as so onerous. It reflects the fact that new services such as the Silver Line, AITC, Green Line-Medford Hillside, and the Blue Line/Red Line connection would allow passengers to reach their destinations without having to make as many transfers.

EFFECTS ON AUTO TRAVEL

Even with auto travel growing at a slower rate than that experienced by transit, roadway VMT are projected to increase. The growth in VMT is 33% for both the 2025 no-build and the 2025 build. Average speeds decline from 32.5 MPH to 29.2 in the no-build scenario and 29.9 in the build scenario due to increases in congestion.

The decrease in VMT for build versus no-build is expected. The number of vehicle trips decreases because of the relative advantage of transit, while the average trip length remains constant. This decrease in VMT means slightly less congested roadways, which explains the increase in average vehicle speed for the build scenario compared to no-build.

Finally, it should be noted that there is a “disequilibrium” underlying the future transportation system as we have modeled it. That is, we have

modeled the probable impacts on the transportation system of a particular set of demographic forecasts; however, we have not done the opposite. We have not modeled the probable impacts of transportation investments, and more importantly, the impacts of investments not made, on the assumed demographic forecasts. If acceptable levels of transportation service are not present in a particular part of the region, it is likely that the growth in population and employment assumed in the demographic forecasts would not occur in the first place. To the extent that this is true, the forecast levels of congestion on the highway system, and even more so on the transit system, are overstated.

TABLE 9-1
Travel Model Results

Socioeconomic Characteristic	1995	2003	% Growth 1995-2003	2025	% Growth 1995-2025
Households	1,544,100	1,661,179	8	1,893,100	23
Ring 0	86,400	93,718	8	108,300	25
Ring 1	288,000	301,156	5	318,300	11
Ring 2	289,400	303,306	5	316,000	9
Ring 3	443,900	472,054	6	540,600	22
Ring 4	436,400	490,945	12	610,000	40
Total Employment	2,133,900	2,385,287	12	2,799,400	31
Ring 0	432,700	471,173	9	567,900	31
Ring 1	285,900	315,611	10	365,300	28
Ring 2	341,900	376,146	10	423,600	24
Ring 3	628,300	707,258	13	819,900	30
Ring 4	445,100	515,099	16	622,800	40
Basic Employment	673,400	645,308	-4	652,300	-3
Ring 0	82,900	77,254	-7	77,200	-7
Ring 1	59,200	58,198	-2	63,300	7
Ring 2	105,000	90,985	-13	82,900	-21
Ring 3	232,900	228,521	-2	229,500	-1
Ring 4	193,400	190,350	-2	199,400	3
Retail Employment	295,800	384,155	30	453,400	53
Ring 0	36,000	43,360	20	49,000	36
Ring 1	36,200	43,463	20	47,200	30
Ring 2	46,500	56,976	23	61,500	32
Ring 3	107,200	137,114	28	161,100	50
Ring 4	69,900	103,242	48	134,700	93
Service Employment	1,164,700	1,355,824	16	1,693,800	45
Ring 0	313,800	350,559	12	441,700	41
Ring 1	190,500	213,950	12	254,900	34
Ring 2	190,400	228,185	20	279,100	47
Ring 3	288,300	341,623	18	429,400	49
Ring 4	181,800	221,507	22	288,700	59

TABLE 9-2
Travel Model Results

	1995	2003	Growth 1995-2003	2025 No-build	Growth 1995-NB	2025 Build	Growth 1995-2025
Population	4,160,082	4,367,171	5.0%	4,765,176	14.5%	4,765,176	14.5%
Households by HH Size	1,544,114	1,661,182	7.6%	1,893,128	22.6%	1,893,128	22.6%
1 person	401,904	463,878	15.4%	597,110	48.6%	597,110	48.6%
2 people	471,997	492,079	4.3%	528,495	12.0%	528,495	12.0%
3 people	269,885	290,260	7.5%	330,095	22.3%	330,095	22.3%
4 people	236,647	246,758	4.3%	262,624	11.0%	262,624	11.0%
5+ people	163,681	168,206	2.8%	174,804	6.8%	174,804	6.8%
Avg HH Size	2.604	2.543	-2.3%	2.442	-6.2%	2.442	-6.2%
Households by HH Income	1,544,114	1,661,182	7.6%	1,893,129	22.6%	1,893,129	22.6%
< \$20,000	371,217	394,136	6.2%	443,138	19.4%	443,138	19.4%
\$20-40,000	397,738	425,417	7.0%	481,154	21.0%	481,154	21.0%
\$40-60,000	335,194	362,180	8.1%	414,533	23.7%	414,533	23.7%
> \$60,000	439,965	479,450	9.0%	554,304	26.0%	554,304	26.0%
Households by Workers/HH	1,544,115	1,661,182	7.6%	1,893,129	22.6%	1,893,129	22.6%
0 workers	356,591	414,210	16.2%	538,040	50.9%	538,040	50.9%
1 worker	531,174	579,008	9.0%	677,473	27.5%	677,473	27.5%
2 workers	490,800	502,620	2.4%	515,583	5.0%	515,583	5.0%
3+ workers	165,550	165,345	-0.1%	162,033	-2.1%	162,033	-2.1%
Avg Work/HH	1.374	1.352	-1.6%	1.245	-9.4%	1.245	-9.4%
Total Workers	2,121,591	2,246,524	5.9%	2,357,651	11.1%	2,357,651	11.1%
Households by Vehicles/HH	1,544,114	1,661,161	7.6%	1,892,877	22.6%	1,892,877	22.6%
0 vehicles	230,060	302,751	31.6%	345,269	50.1%	345,513	50.2%
1 vehicle	551,597	618,995	12.2%	713,435	29.3%	714,406	29.5%
2 vehicles	550,212	506,620	-7.9%	581,756	5.7%	580,780	5.6%
3+ vehicles	212,245	232,796	9.7%	252,416	18.9%	252,178	18.8%
Avg Veh/HH	1.51	1.43	-5.2%	1.42	-6.1%	1.42	-6.1%
Total Vehicles	2,331,612	2,377,181	2.0%	2,684,680	15.1%	2,682,935	15.1%

TABLE 9-3
Travel Model Results

TRIP PRODUCTIONS		1995	2003	Growth 1995-2003	2025 No-build	Growth 1995-NB	2025 Build	Growth 1995-2025
Total		16,314,955	17,668,925	8.3%	20,455,101	25.4%	20,455,769	25.4%
Ring 0		1,174,648	1,318,611	12.3%	1,675,723	42.7%	1,675,725	42.7%
Ring 1		2,770,778	2,925,824	5.6%	3,156,290	13.9%	3,156,338	13.9%
Ring 2		2,761,641	2,892,591	4.7%	2,989,336	8.2%	2,989,595	8.3%
Ring 3		4,535,449	4,832,166	6.5%	5,366,621	18.3%	5,366,889	18.3%
Ring 4		4,165,297	4,709,746	13.1%	5,704,602	37.0%	5,704,693	37.0%
Rings 0-4		15,407,813	16,678,938	8.2%	18,892,572	22.6%	18,893,240	22.6%
Externals		907,142	989,987	9.1%	1,562,529	72.2%	1,562,529	72.2%
Home-based Work		3,271,617	3,475,312	6.2%	4,893,381	25.1%	4,093,473	25.1%
Rings 0-4		2,846,813	3,005,465	5.6%	3,153,921	10.8%	3,154,013	10.8%
Externals		424,804	469,847	10.6%	939,460	121.2%	939,460	121.2%
HB Personal Bus		4,183,441	4,436,744	6.1%	5,034,878	20.4%	5,035,442	20.4%
Rings 0-4		3,973,146	4,211,389	6.0%	4,767,919	20.0%	4,768,483	20.0%
Externals		210,295	225,355	7.2%	266,959	26.9%	266,959	26.9%
HB Social-Rec		2,978,211	3,138,163	5.4%	3,471,046	16.5%	3,471,046	16.5%
Rings 0-4		2,864,972	3,016,196	5.3%	3,324,928	16.1%	3,324,928	16.1%
Externals		113,239	121,967	7.7%	146,118	29.0%	146,118	29.0%
HB School		981,490	1,008,657	2.8%	1,070,375	9.1%	1,070,375	9.1%
Rings 0-4		962,151	987,936	2.7%	1,045,858	8.7%	1,045,858	8.7%
Externals		19,339	20,721	7.1%	24,517	26.8%	24,517	26.8%
HB Pickp/Drop		637,031	649,527	2.0%	705,727	10.8%	705,739	10.8%
Rings 0-4		593,428	602,597	1.5%	649,644	9.5%	649,656	9.5%
Externals		43,603	46,930	7.6%	56,083	28.6%	56,083	28.6%
Non-HB Work		2,259,436	2,630,091	16.4%	3,199,663	41.6%	3,199,663	41.6%
Rings 0-4		2,188,805	2,552,843	16.6%	3,105,000	41.9%	3,105,000	41.9%
Externals		70,631	77,248	9.4%	94,663	34.0%	94,663	34.0%
Non-HB Other		2,003,719	2,330,431	16.3%	2,880,031	43.7%	2,880,031	43.7%
Rings 0-4		1,978,488	2,302,512	16.4%	2,845,302	43.8%	2,845,302	43.8%
Externals		25,231	27,919	10.7%	34,729	37.6%	34,729	37.6%

TABLE 9-3 (CONT.)
Travel Model Results

TRIP ATTRactions		1995	2003	Growth 1995-2003	2025 No-build	Growth 1995-NB	2025 Build	Growth 1995-2025
Total		16,314,522	17,666,677	8.3%	20,454,389	25.4%	20,455,058	25.4%
Ring 0		1,844,376	1,995,609	8.2%	2,499,621	35.5%	2,499,677	35.5%
Ring 1		2,620,423	2,710,343	3.4%	3,005,491	14.7%	3,005,597	14.7%
Ring 2		2,686,013	2,806,854	4.5%	2,980,892	11.0%	2,980,996	11.0%
Ring 3		4,717,977	5,103,563	8.2%	5,793,565	22.8%	5,793,763	22.8%
Ring 4		3,794,579	4,331,267	14.1%	5,263,390	38.7%	5,263,595	38.7%
Rings 0-4		15,663,368	16,947,636	8.2%	19,542,959	24.8%	19,543,628	24.8%
Externals		651,154	721,041	10.7%	911,430	40.0%	911,430	40.0%
Home-based Work		3,271,640	3,475,373	6.2%	4,093,381	25.1%	4,093,719	25.1%
Rings 0-4		3,113,454	3,299,810	6.0%	3,153,921	1.3%	3,870,370	24.3%
Externals		158,186	175,563	11.0%	939,460	493.9%	223,349	41.2%
HB Personal Bus		4,183,488	4,436,836	6.1%	5,034,878	20.4%	5,035,465	20.4%
Rings 0-4		3,973,159	4,202,938	5.8%	4,767,919	20.0%	4,736,751	19.2%
Externals		210,329	233,898	11.2%	266,959	26.9%	298,714	42.0%
HB Social-Rec		2,978,247	3,138,204	5.4%	3,471,046	16.5%	3,471,072	16.5%
Rings 0-4		2,848,691	2,994,212	5.1%	3,324,928	16.7%	3,287,378	15.4%
Externals		129,556	143,992	11.1%	146,118	12.8%	183,694	41.8%
HB School		981,511	1,008,687	2.8%	1,070,375	9.1%	1,070,407	9.1%
Rings 0-4		954,170	979,770	2.7%	1,045,858	9.6%	1,037,208	8.7%
Externals		27,341	28,917	5.8%	24,517	-10.3%	33,199	21.4%
HB Pkwy/Drivfr		636,461	649,043	2.0%	705,727	10.9%	705,249	10.8%
Rings 0-4		606,954	616,049	1.5%	649,644	7.0%	662,670	9.2%
Externals		29,507	32,994	11.8%	56,083	90.1%	42,579	44.3%
Non-HB Work		2,259,451	2,630,105	16.4%	3,199,663	41.6%	3,199,628	41.6%
Rings 0-4		2,188,354	2,552,361	16.6%	3,105,000	41.9%	3,104,385	41.9%
Externals		71,097	77,744	9.3%	94,663	33.1%	95,243	34.0%
Non-HB Other		2,003,724	2,330,429	16.3%	2,880,031	43.7%	2,879,518	43.7%
Rings 0-4		1,978,586	2,302,496	16.4%	2,845,302	43.8%	2,844,866	43.8%
Externals		25,138	27,933	11.1%	34,729	38.2%	34,652	37.8%

TABLE 9-4
Mode Split Model Results: 1995, 2003B, 2025NB and 2025B

INTRAREGIONAL PERSON TRIPS															
TIME PERIOD	1995			2003 Build			YEAR			2025 No-Built			2025 Build		
	Mode	Share	% Change	Mode	Share	% Change	Mode	Share	% Change	Mode	Share	% Change	Mode	Share	% Change
AM Peak 6:00 - 9:00 AM															
Transit	177,220		17.04%	207,3400		18.59%	263,000		48.42%	270,200		52.48%			
Auto	1,576,100		4.97%	1,654,400		9.28%	1,727,100		9.58%	1,720,700		9.17%			
Walk	301,500		5.67%	318,600		13.30%	360,600		19.60%	359,900		19.37%			
Subtotal - All Modes	2,054,800		6.11%	2,180,400		10.46%	2,350,700		14.40%	2,350,800		14.41%			
Midday 9:00 AM - 3:00 PM															
Transit	241,000		18.59%	285,800		18.59%	347,700		44.27%	355,100		47.34%			
Auto	3,866,500		9.28%	4,225,300		9.28%	4,763,100		23.19%	4,760,500		23.12%			
Walk	919,700		13.30%	1,042,000		13.30%	1,312,100		42.67%	1,307,500		42.17%			
Subtotal - All Modes	5,027,200		10.46%	5,553,100		10.46%	6,422,900		27.76%	6,423,100		27.77%			
PM Peak 3:00 - 6:00 PM															
Transit	206,600		17.13%	242,000		17.13%	308,800		49.47%	317,200		53.53%			
Auto	2,591,800		7.62%	2,789,400		7.62%	3,050,000		17.68%	3,043,900		17.44%			
Walk	487,000		9.59%	533,700		9.59%	668,100		37.19%	666,000		36.76%			
Subtotal - All Modes	3,285,400		8.51%	3,565,100		8.51%	4,026,900		22.57%	4,027,100		22.58%			
Night 6:00 PM - 6:00 AM															
Transit	151,200		17.92%	178,300		17.92%	210,300		39.09%	219,700		45.30%			
Auto	3,137,200		5.93%	3,323,100		5.93%	3,659,600		16.65%	3,654,000		16.47%			
Walk	524,000		9.69%	574,800		9.69%	686,700		31.05%	683,100		30.36%			
Subtotal - All Modes	3,812,400		6.92%	4,076,200		6.92%	4,556,600		19.52%	4,556,800		19.53%			
Total Daily															
Transit	776,000	5.47%	17.72%	913,500	5.94%	17.72%	1,129,800	6.51%	45.59%	1,162,200	6.70%	49.77%			
Auto	11,171,600	78.79%	7.35%	11,992,200	78.00%	7.35%	13,199,800	76.05%	18.15%	13,179,100	75.93%	17.97%			
Walk	2,232,200	15.74%	10.61%	2,469,100	16.06%	10.61%	3,027,500	17.44%	35.63%	3,016,500	17.38%	35.14%			
Subtotal - All Modes	14,179,800		8.43%	15,374,800		8.43%	17,357,100		22.41%	17,357,800		22.41%			

TABLE 9-5
Travel Model Results

BASED ON NEW MODEL/ NEW SOCIOECONOMIC FORECASTS							
Socioeconomic and Transportation Measures	1995	2003	Growth	2025	Growth	2025	Growth
	Base Year	Build	1995-2003B	No-Build	1995-2025NB	Build	1995-2025B
Population	4,160,100	4,367,200	5%	4,765,100	15%	4,765,100	15%
Households	1,544,100	1,661,200	8%	1,893,100	23%	1,893,100	23%
Employment	2,133,900	2,385,300	12%	2,799,400	31%	2,799,400	31%
Person Trips(Weekday)							
Total intraregional trips	14,179,800	15,374,800	8%	17,357,100	22%	17,357,800	22%
Total linked transit trips	776,100	913,500	18%	1,129,900	46%	1,162,200	50%
Total walk trips	2,232,100	2,469,100	11%	3,027,500	36%	3,016,500	35%
Intraregional auto trips	11,171,600	11,992,200	7%	13,199,700	18%	13,179,100	18%
Intraregional transit mode share	5.47%	5.94%	9%	6.51%	19%	6.70%	22%
Transit boardings (Weekday)							
Total commuter rail	93,400	147,700	58%	236,900	154%	253,500	171%
Total rapid transit lines	676,500	811,700	20%	1,013,100	50%	1,037,000	53%
Total local buses	365,600	464,800	27%	477,500	31%	555,100	52%
Total express buses	35,000	41,400	18%	59,000	69%	50,700	45%
Total transit boardings	1,170,500	1,465,6050	25%	1,786,500	53%	1,896,300	62%
Transfer rate	151%	160%	6%	158%	5%	163%	8%
Highway Statistics (Weekday)							
Total assigned vehicle trips	10,381,700	11,404,500	10%	13,050,900	26%	13,044,600	26%
Total vehicle miles traveled	108,800,100	118,830,000	9%	143,939,800	32%	143,511,100	32%
Total vehicle hours traveled	3,349,300	3,749,100	12%	4,931,100	47%	4,805,800	43%
Average vehicle speed (MPH)	32.5	31.7	-2%	29.2	-10%	29.9	-8%
Average vehicle trip length (miles)	10.5	10.4	-1%	11.0	5%	11.0	5%

TABLE 9-6
Commuter Rail and Rapid Transit Boardings: 1995, 2003B, 2025NB and 2025B

DAILY BOARDINGS						
Line Haul System	Total 1995	Year 2003	Change 95-2003 Build	Year 2025	Change 95-25NB No-Build	Year 2025 95-25B Build
COMMUTER RAIL (CRR)						
Northside Total	36,600	50,100	37%	96,400	163%	101,500 177%
Southside Total	56,800	97,600	72%	140,500	147%	152,000 168%
CRR Total	93,400	147,700	58%	236,900	154%	253,500 171%
RAPID TRANSIT (RT)						
Blue Line Total	59,000	68,800	8%	74,600	26%	89,800 52%
Orange Line Total	167,200	191,800	15%	246,400	47%	219,000 31%
Mattapan Line Total	8,500	11,000	29%	12,400	46%	12,300 45%
Red Line Total	220,500	281,400	28%	375,100	70%	370,100 68%
Green Line Total	221,300	263,600	19%	304,600	38%	345,800 56%
RT Total	676,500	811,600	20%	1,013,100	50%	1,037,000 53%



CHAPTER

10

RECOMMENDED PLAN

BACKGROUND

The recommended set of projects contained in this chapter represents an extremely constrained list of projects and enhancements. This list is primarily composed of those projects that are legal commitments under environmental or legislative regulations, are currently programmed in the six year Boston MPO Transportation Improvement Program (FY 2001-2006 TIP). This constrained list will require the Boston MPO to continue work on long range transportation planning in preparation of an expanded 2001-2025 Transportation Plan.

Due to the uncertainties of future financial resources available to the MPO as of Fall 2000, the MPO decided to take a very conservative fiscal stance in constructing the list of projects in this recommended plan. Using the information contained in Chapter 11, Financial Plan, the MPO will be able to further analyze the financial resources available to the MPO over the next 25 years and make decisions as to what additional projects to include in the updated 2001-2025 Transportation Plan.

A fundamental decision to be made by the MPO is determining the proper amount of money to allocate among infrastructure, maintenance, system enhancements, accessibility improvements and system expansions. The roadway and transit network in the Boston region is a mature one compared to most other parts of the United States. Many of today's roadways, bridges and transit lines were first laid out in the early 1800s and have been progressively added upon and rebuilt over the past two hundred years. An example of this is the restoration of commuter rail service along the Old Colony lines. Commuter rail passenger service was first instituted along these lines in 1845, abandoned in 1959 with the opening of Route 3 South as a limited-access highway, and re-instituted along two of the branches in 1997. Route 128 was a system of local connecting roads long before it was redeveloped as the first circumferential highway in the United States in the 1950s.

RECOMMENDED LIST OF PROJECTS

Reinvestment in the existing system is the top priority of the Boston MPO. In this plan, the MPO has allocated 70% of future transit capital funding for system infrastructure maintenance, accessibility improvements and system enhancements. The remaining 30% is allocated to transit expansions.

On the roadway side, this plan allocates 70% of future capital highway funding to maintaining the existing infrastructure, exclusive of funding the construction of the Central Artery. The remaining 30% is allocated to allow for roadway expansion, additional emphasis on maintenance or transportation demand measures. These allocations relate to MBTA, Transportation Improvement Program, and other Mass Highway projects only. Cape Ann Transportation Authority (CATA) funding and local Chapter 90 funds are not included.

The recommended list of projects that comprise the Transportation Plan must satisfy a number of complementary and sometimes competing policy goals. Taken as a whole, the recommended plan must:

- Be fiscally constrained as determined by available and expected revenues
- Meet air quality standards set by the U.S. Environmental Protection Agency
- Comply with the Americans with Disabilities Act by providing access to all regardless of disability
- Meet Environmental Justice standards as described in federal statute and regulations
- Provide for public comment and citizen involvement in the development of the plan

Figure 10-1 lists those projects included in the recommended plan. It shows a five-year time period denoting when the final project will come on line and if the project was included in the air quality conformity analysis. Below are further explanations for each of the columns. A more in depth description of each project in Figure 10-1 is included in Appendix A: Projects Included in the Transportation Plan.

5-year period project will be completed: This column denotes when a project will be completed and open to the public in five-year increments. Most of these projects have construction periods that span multiple years. And some of these projects may be opened in phases, such as Telecom City Roadways and Green Line Accessibility. The chart reflects the final completion of all the phases for each project.

Project cost: The project costs are listed in millions of dollars and are estimates of final completion costs in 2000 dollars. For projects that are currently under construction, the cost listed is for total costs remaining as of federal fiscal year 2001 and beyond. For example, the Central Artery has a cost estimate of \$4,952,800,000 remaining as of October 1, 2000. Some projects do not have a cost estimate listed because the total cost of those projects has already been obligated prior to October 1, 2000.

Included in model for Air Quality: As required by federal regulation, projects of regional significance, that are not specifically exempt, are included in the travel demand model for air quality conformity purposes. Chapter 13, Air Quality Conformity Determination, contains a more in-depth explanation of the types of projects that must be included in the regional model.

Only those specific projects that are “regionally significant” or exempt projects that are sufficiently large enough in scope or cost are specifically listed in Figure 10-1. Only “regionally significant” projects are required to be included in the regional travel demand model efforts. The conformity regulations define “regionally significant” as follows:

** Regionally significant: a transportation project (other than an exempt project) that is on a facility which serves regional transportation needs (such as access to and from the area outside of the region, major activity centers in the region, major planned developments such as new retail malls, sport complexes, etc., or transportation terminals as well as most terminals themselves) and*

TABLE 10-1
Regionally Significant and Other Large Projects

	5-year period Project will be completed	Remaining Cost (Mil.) (Oct. 1, 2000)	Included in model for Air Quality
Roadway Projects			
Central Artery	2000-2005	\$ 4,517.8	Yes
I-495 Interchange (Marlborough/Southborough)	2000-2005	\$ -	Yes
Quincy Center Concourse, Phase 1	2000-2005	\$ -	Yes
Route 38 (Wilmington)	2000-2005	\$ 3.0	Yes
Massachusetts Ave./Lafayette Square - Cambridge	2000-2005	\$ 4.4	Yes
Foxborough Route 1 Improvements	2000-2005	\$ 14.0	Yes
Canton I-95 Dedham Street Ramps	2000-2005	\$ 1.2	Yes
Route 20 Marlborough	2000-2005	\$ 7.2	Yes
Route 3 North Burlington to NH Border Widening	2000-2005	\$ 640.0	Yes
Cambridgeport Roadways	2000-2005	\$ 3.0	Yes
Route 53 Hingham/Norwell	2000-2005	\$ 4.0	Yes
Route 128 Additional Lane	2006-2010	\$ 97.0	Yes
Franklin Route 140	2006-2010	\$ 18.0	Yes
Telecom City Roadways	2006-2010	\$ 24.9	Yes
Bridge St. Bypass Salem	2006-2010	\$ 12.3	Yes
Crosby Drive - Bedford	2006-2010	\$ 3.5	Yes
Middlesex Turnpike, Bedford/Burlington	2006-2010	\$ 9.0	Yes
Route 2 Crosby's Corner, Concord/Lincoln	2006-2010	\$ 10.5	Yes
Needham St. (Highland Ave.) Needham/Newton	2006-2010	\$ 6.6	Yes
Transit Projects			
Worcester Commuter Rail - Full Service	2000-2005	\$ -	Yes
South Boston Piers Transitway, Phase 1	2000-2005	\$ 285.0	Yes
Silver Line - Washington Street	2000-2005	\$ 54.0	Yes
Greenbush - Old Colony	2000-2005	\$ 400.0	Yes
Arborway Restoration	2000-2005	\$ 59.0	Yes
Additional Park & Ride Spaces	2000-2005	\$ 5.3	Yes
Airport Intermodal Transit Connector (AITC)	2000-2005	\$ 35.0	Yes
North Station Improvements	2000-2005	\$ 110.0	No
Blue Line Platform Lengthening & Modernization	2000-2005	\$ 226.0	No
Bus Maintenance facilities	2000-2005	\$ 80.0	No
Mattapan Refurbishment	2000-2005	\$ -	No
Russia Ferry Wharf - South Station	2000-2005	\$ 5.0	No
Green Line Vehicles - Type 8	2000-2005	\$ 122.0	No
Blue Line Vehicles	2000-2005	\$ 200.0	No
Low Emission Buses	2000-2005	\$ 126.0	No
Ashmont Station Modernizations	2000-2005	\$ 83.0	No
Charles Street Station Modernization	2000-2005	\$ 27.0	No
Automated Fare Collection	2000-2005	\$ 120.0	No
Silver Line Phase B - NEMC to South Station	2006-2010	\$ 713.0	Yes
Green Line Accessibility	2006-2011	\$ 124.0	No
Green Line - Medford Hillside Extension (Ball Square)	2011-2015	\$ 375.0	Yes
Blue Line - Red Line Transit Connection (Charles-Bowdoin)	2011-2015	\$ 220.0	Yes
Intermodal Projects			
AMTRAK Northeast Corridor Electrification	2000-2005	\$ -	Yes
AMTRAK Service to Portland, Maine	2000-2005	\$ -	Yes
Industriplex Intermodal Center (Woburn)	2000-2005	\$ 1.0	Yes

would be included in the modeling of a metropolitan area's transportation network, including at a minimum all principal arterial highways and all fixed guideway transit facilities that offer an alternative to regional highway travel.

In addition specific types of projects have been made exempt from regional modeling emissions analysis. The categories of projects include:

- Intersection channelization projects
- Intersection signalization projects at individual intersections
- Interchange reconfiguration projects
- Changes in vertical and horizontal alignment
- Truck size and weight inspection stations
- Bus terminals and transfer points

Most of the work of the MPO in the future will be devoted to the maintenance of its existing infrastructure. This is work that does not add capacity to the system but rather extends the life or modernizes the components of the system. Therefore, these types of projects are not specifically listed in Figure 10-1. These projects are contained within the following maintenance and enhancement categories:

Roadways

Bridge maintenance and rehabilitation:

Over the next twenty-five years, the MPO will need to maintain the set of bridges within the region. This includes replacing bridge decks, painting and other maintenance needs. MassHighway oversees the rating all state bridges, including those owned by the MBTA. As freight rail bridges are rehabilitated, the MPO will make every effort to allow for double-stack

freight rail clearance. In some cases a functionally obsolete bridge that is rehabilitated may remain functionally obsolete in order to maintain the character of the bridge and the surrounding land-use pattern. A new bridge or a bridge that substantially increased roadway capacity would have to be listed as a regionally significant project and listed in Figure 10-1.

Interstate maintenance: The interstate maintenance program is overseen by MassHighway and ensures that the system of interstate highways within the region are maintained to an acceptable standard.

Pavement maintenance: MassHighway and the local communities maintain an ongoing pavement management program that tries to maintain and extend the useful life of the pavement of the region's roadways.

Safety: Safety projects address specific roadway safety issues identified through data analysis performed by the MPO and MassHighway. Safety projects include a hazard elimination program,

shoulder improvements, and intersection realignments. The MPO maintains a GIS database of crash locations and is able to rank these intersections or stretches of roadway most in need of improvement.

Intersection/signal improvements: This category includes intersection channelization projects, signal upgrades, and realign-

ments. This category does not include intersections or segments of roadway that add additional roadway capacity. Those projects are subject to air quality conformity analysis and must be specifically identified in Figure 10-1.



Bicycle and pedestrian

Enhancements

Bicycle and pedestrian: The MPO will continue to fund trails, pedestrian amenities and other enhancement projects as part of its Congestion Management Air Quality (CMAQ) program. Two trails are included in the recently adopted 2001 Transportation Improvement Program and several others are in various stages of planning. The provision of bicycle access in the design of all roadway reconstruction projects is a legislative mandate to MassHighway. The provision of sidewalks where absent is also part of the design process for highway reconstruction projects.

TDM: Transportation demand management strategies will continue to be implemented and funded within the region. This includes both capital and operating measures. Project funding has included shuttle services, park and ride lots, and bicycle projects. Currently, there are 12 Transportation Management Associations within the region working to provide commuters with alternatives to driving alone. As the roadway network becomes even more congested, the importance of more efficiently managing the use of the roadways will become even more critical. The MPO has and continues to fund TMA projects.

ITS: Intelligent Technology Strategies are being employed by each of the Boston MPO transportation agencies. MassTurnpike has instituted the FastPass program that allows for electronic toll collection at MassTurnpike facilities, and selected MBTA and Massport facilities. The system is compatible with the EZ Pass system in use along the I-95 corridor from New York to Delaware. The MBTA is in the process of instituting an Automated Fare Collection (AFC) system with "smart technology" that allows for peak/off peak

period pricing, transit transfers and better control over fare collection. The MBTA is constructing a bus control center to better track its buses en route and be able to alert the public to schedule adherence.

Transit

Track, Signal and Right of Way maintenance:

The MBTA must maintain its track, signals and right of way in good working order. Scheduled projects over the next five years will include track and signal work on the Orange Line.

Vehicle procurement: The MBTA must maintain a schedule of design and purchase of its vehicle fleet. Some

vehicle fleet purchases are large enough in scope to be listed in Figure 10-1. New handicapped-accessible Type 8 Green Line cars and new Blue Line cars are two examples. Each of these procurements cost over \$200 million. Also, the MBTA is committed to the purchase of low-emission buses.

Vehicle rehabilitation: This category includes the refurbishment of transit service vehicles to extend their useful life or retrofit current equipment to reduce air pollutants. Vehicle rehabilitation currently underway includes the Mattapan High Speed Line PCC cars, commuter rail cars and diesel buses.

Station modernization: The MBTA implements station modernization program to maintain and update transit stations. All Blue Line stations from Wood Island to Wonderland have completed a station modernization over the past five years. Aquarium Station is currently under construction in conjunction with the Central Artery project.



The four stations on the Ashmont branch of the Red Line are in the early stages of modernization.

Accessibility: The MBTA is working toward full compliance with the Americans with Disabilities Act (ADA). Current and future work will focus on bringing the Green Line (vehicles and stations)

and the few remaining Red Line stations along the Ashmont branch into compliance. In many cases station modernization programs incorporate the need for providing accessibility into the project. An example of this is the Blue Line station modernization program currently underway.

FUTURE VISION PROJECTS

As explained earlier in this chapter and elsewhere in the document, the recommended set of projects for this Transportation Plan is extremely constrained due to a need to clarify future funding levels, determine spending priorities and to evaluate transportation and land use scenarios. It is the MPO's intention to continue work on the development of projects for future consideration, analysis of funding assumptions and exploration of alternative land use scenarios. Because of this many projects that might have been included were deferred for further consideration for inclusion in the 2001-2025 Transportation Plan. There were projects included in the 1997 Transportation Plan that were not included in this constrained plan. Full consideration will be given to including these projects as part of the recommended Transportation Plan when the MPO updates the Transportation Plan in Summer 2001. As shown in Chapter 11, Financial Plan, the MPO has identified additional capital money that can be allocated to additional transportation projects or programs in the future. The additional capital available amounts to approximately \$1.95 billion over the twenty-five year period.

These projects are still in various stages of project development or planning or are so financially costly that the MPO decided it needed more time to study all the implications involved in including them in the Transportation Plan. Transit projects still under study include North-South Rail Link, Urban Ring, Fall River/New Bedford Commuter Rail, upgrade of the Fairmount Commuter Rail, Orange Line/Assembly Square, the North Shore MIS and refinement of transit needs for the South Boston Piers area. Highway projects that need further study include Route 3 South, the lower North Shore area of Route 1/Route 16 and roadway improvements associated with the redevelopment of the Weymouth Naval Air Station. In addition to the larger projects, there are many other smaller projects under study that could potentially merit study.



CHAPTER

11

FINANCIAL PLAN

Federal transportation planning regulations require the Regional Transportation Plan (RTP) to include a financial plan that demonstrates the consistency of proposed transportation projects with available and projected sources of revenue. The financial plan must compare the estimated transportation revenue from existing and available sources, both public and private, with the estimated cost of constructing, maintaining, and operating the total transportation system over the period covered by the RTP. If this comparison reveals a revenue shortfall, the financial plan must identify proposed sources of additional revenue necessary to cover the shortfall and provide strategies for ensuring the availability of such revenue.

This financial plan is limited to a review of the components of the regional transportation system over which the Metropolitan Planning Organization assumes some funding or programming jurisdiction. These components are the Central Artery Project, the statewide road and bridge system, and the regional public transportation system.

THE CENTRAL ARTERY PROJECT

In October 2000, the Massachusetts Turnpike Authority submitted the Central Artery Finance Plan to the Federal Highway Administration. The MPO has reviewed the finance plan and believes the projections contained in the plan are sound. Therefore, the MPO has decided to base the cost and revenue projections for the Central Artery Project in the Regional Transportation Plan on the Central Artery Finance Plan.

The total cost of the Central Artery Project is estimated to be approximately \$14.075 billion. At the end of state fiscal year 2000 (June 30, 2000), funds obligated for use on the project totaled approximately \$10.008 billion, leaving \$4.067 billion to be obligated. However, approximately \$1.284 billion of the previously obligated amount came from the issuance of Grant Anticipation Notes (GANs). Grant Antici-

pation Notes are short term debt that is backed by a pledge of federal revenue; the state funds yearly interest payments from annual appropriations, while principal payments will be drawn from future federal highway apportionments. Since the repayment of GANs is a funding requirement of the RTP, the future to-go obligations of the Project for the purposes of this financial plan total approximately \$5.351 billion. These to-go obligations will be funded from a combination of federal-aid, state funds and third-party funds.

Two distinct funding caps limit the federal-aid available for the Central Artery Project. The first cap, which was developed in 1995/96 by the state, the Federal Highway Administration (FHWA), and the state's MPOs, provides that the Project is to receive 71% of the state's federal-aid apportionment through FY 2002 and 50% thereafter until final payout. The second cap which was imposed by FHWA on May 8, 2000, limits overall federal obligations for the Project to \$8,549,000,000 (\$7.049 billion in contract obligations and \$1.5 billion for the repayment of GANs).

To-date, of the \$8.549 billion in federal-aid available to the project, approximately \$5.965 billion has been obligated, leaving approximately \$2.584 billion in remaining obligations. These remaining obligations will be funded as shown in Table 11-1.

The available federal-aid highway funds will be used to fund Project contracts (\$1.084 billion) and the repayment of Grant Anticipation Notes (\$1.5 billion). Funding for GANs repayment will begin with approximately \$137.0 million in FY 2004, will use \$262.4 million each fiscal year from FY 2005 through FY 2009, and will conclude with a final payment of \$51 million in FY 2010.

Like all federally funded highway projects, the Central Artery Project requires matching funds from state sources. To-date, the state has obligated approximately \$1.131 billion of Project costs through the issuance of bonds and notes. In addition to these previously obligated funds, the Central Artery Finance Plan envisions the state obligating an additional \$2.238 billion.

The issuance of General Obligation Bonds is limited by the state to no more than \$1 billion per year. In recent years, transportation bonds have accounted for over half of the annual bond cap, much of which has been used to fund the Project. Current plans for the Project call for the issuance of \$532 million in state bonds between state fiscal year 2001 and 2005, below the amount historically made available to the Project and well within the fiscal capacity of the state. Of this \$532 million, approximately \$198 million will be used to fund previously obligated costs, leaving \$334 million for future obligation needs.

TABLE 11-1
Federal-Aid Highway Funds Available for the Central Artery Project
(\$,thousands)

	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Apportionment	\$553,650	\$524,731	\$524,736	\$524,736	\$524,736
Artery Cap	71%	71%	50%	50%	50%
Available Funds	\$324,000	\$372,559	\$262,368	\$262,368	\$262,368
	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
Apportionment	\$524,736	\$524,736	\$524,736	\$524,736	\$524,736
Artery Cap	50%	50%	50%	50%	N/A
Available Funds	\$262,368	\$262,368	\$262,368	\$262,368	\$51,000

Note: Available funds for FY 2001 do not equal 71% of the Apportionment because, pursuant to the Central Artery Finance Plan, they are based on obligation levels instead of apportionment.

In addition to these General Obligation Bonds, the state has recently taken steps to provide a large infusion of funds for the Project. In May 2000, the state passed enabling legislation creating the Central Artery and Statewide Road and Bridge Transportation Infrastructure Trust Fund (the Infrastructure Trust Fund). The trust fund is funded, in part, with the proceeds of annual driver license fees and biennial vehicle registration fees, which are expected to generate approximately \$100 million annually. This revenue stream is sufficient to fund approximately \$1.35 billion in General Obligation or Special Obligation Bonds. Further, assuming that half of these bonds are issued at a variable rate, the Central Artery Finance Plan projects excess revenues in the amount of \$231 million to be generated between 2000 and 2005 for use on the Project.

The Infrastructure Trust Fund will also be generating approximately \$832 million in revenue above and beyond the excess license and registration fees. The fund's enabling legislation provides for the use of \$650 million in budget surpluses to prepay existing debt. This bond defeasement will result in a reduction in future debt service payments (principal and interest) of approximately \$664 million through state fiscal year 2002. Additionally, the enabling legislation provides that funds in the Infrastructure Trust Fund shall be invested, with the interest earned accruing back to the fund. Based upon a financial plan developed

by the Treasurer's Office, it is expected that this interest will total approximately \$159 million. Of this \$832 million in fund revenue, \$500 million is reserved for the Statewide Road and Bridge Program, leaving \$332 million for use on the Project.

Table 11-2 provides a breakdown of the sources of the remaining state obligations for the Project.

In addition to federal-aid and state funds, the Central Artery Project has received a large amount of third-party contributions. These contributions have been provided by the Massachusetts Port Authority (Massport) and the Massachusetts Turnpike Authority (MassPike). Combined, the two authorities have obligated approximately \$1.643 billion to the Project and will obligate an additional \$515 million between 2000 and 2005.

As part of the creation of the Metropolitan Highway System (MHS) in 1997, a feasibility study was conducted to determine an appropriate contribution level for the purchase of certain segments of the Project by the Massachusetts Port Authority. The feasibility study concluded that Massport should pay \$300 million for these assets. Massport scheduled these payments in installments between 1998 and 2005, so as to prevent any disruption to its own capital program. To-date, Massport has obligated approximately \$289 million of this debt, leaving \$11 million remaining.

In addition to these obligations, the enabling legislation for the Infrastructure Trust Fund requires Massport to contribute \$65 million to the fund on or before December 31, 2000.

The Massachusetts Turnpike Authority has obligated approximately \$1.354 billion to the Central Artery Project since 1996 and plans to obligate another \$438 million. Upon the passage of the MHS legislation, MassPike restructured its outstanding debt so as to generate surplus cash flow during the

TABLE 11-2
Source of Remaining State Obligations for the
Central Artery Project (\$,thousands)

General Obligation Bonds	\$334,000
Infrastructure Trust Fund (ITF)	
General or Special Obligation Bonds	\$1,350,000
Excess License & Registration Fees	\$231,000
Debt Service Avoidance	\$164,000
Accrued Interest	\$159,000
Subtotal of ITF	\$1,904,000
Total	\$2,238,000

Note: For ease of accounting, the \$500 million dedicated to the Statewide Road and Bridge Program has been deducted from Debt Service Avoidance.

Project's peak construction period. In recognition of this fact, the Infrastructure Trust Fund enabling legislation mandates a \$200 million contribution from MassPike to the fund. This contribution was made on September 1, 2000, but has not yet been obligated for the Project. In addition to this contribution, MassPike recently dedicated to the Project the proceeds of the sale of certain properties. In July 2000, MassPike sold to Harvard University 48 acres, known as the "Allston Landing Parcels," for \$151.8 million. These proceeds have been deposited in an MHS interest-bearing reserve account. It is expected that the interest generated by this account will provide an additional \$33 million for use on the Project. Finally, MassPike will also be contributing an additional \$53 million for projects that were categorized as a non-Artery cost under previous finance plans.

As mentioned earlier, the remaining to-go obligation costs for the Central Artery Project are approximately \$5.351 billion, including \$1.5 billion for the repayment of principal on Grant Anticipation Notes. Table 11-3 provides a breakdown of the revenues that will be used to fund these obligations.

TABLE 11-3
Revenue to Fund the Remaining Central Artery Project Obligations (\$,thousands)

Federal-Aid Highway Funds	\$2,584,000
State Funds	\$2,238,000
Massport Funds	\$76,000
MassPike Funds	\$438,000
Total Funds	\$5,336,000

Note: The minor discrepancy between the to-go costs and available funds is the result of using federal fiscal years for the projection of available federal-aid, while basing to-go costs exclusively on the state fiscal year.

As shown by Table 11-3, the state has sufficient financial resources to complete the construction of the Central Artery Project. Once completed in 2005, the Project will be operated and maintained by the Massachusetts Turnpike Authority. In 1996 the state commissioned a feasibility study of the

Metropolitan Highway System (MHS). As recommended in the feasibility study, the Metropolitan Highway System consists of the Boston Extension of the Massachusetts Turnpike (Boston to Route 128), the three harbor tunnels (Callahan, Sumner, and Williams), the Central Artery, and the extension of the Turnpike from South Bay to the Ted Williams Tunnel.

The MHS Feasibility Study found that under the system as it existed in 1996 there would be an operating deficit for the MHS. In response to this concern, the MHS enabling legislation provides for an annual \$25 million contribution from MassHighway toward the maintenance of the Central Artery. In addition, MassPike doubled the tolls on the harbor tunnels in 1997 and, if necessary, will increase tolls on the MHS in the future as needed to fund any operating shortfalls.

THE STATEWIDE ROAD AND BRIDGE SYSTEM

At the present time, the amount of funds available for the Statewide Road and Bridge Program is, to a large degree, a function of the funding needs of the Central Artery Project. In recognition of that fact, in September 2000, the state and its MPOs executed a Memorandum of Understanding of the Task Force of State and Regional Officials to Define, Develop and Monitor a Statewide Road and Bridge Program (Statewide Road and Bridge MOU). The Statewide Road and Bridge MOU commits MassHighway to expend no less than \$400 million per year on transportation projects for the remaining years of Artery construction, through state fiscal year 2005. According to MassHighway, given the recent and historic trends concerning payouts for previously obligated projects, an expenditure of \$400 million per year translates into an annual advertising program of approximately \$200-\$250 million.

For programming and planning purposes, the Massachusetts Association of Regional Planning Agencies (MARPA) has developed targets to apportion highway funding among the MPOs. Under the MARPA targets, the Boston MPO assumes that it will receive approximately 43% of

all available highway funds. Based on that assumption and MassHighway's expectations regarding the statewide advertising program, the Boston MPO can expect to receive between \$86.0 million and \$107.4 million per year between FY 2001 and FY 2005. This projection is in line with previous trends; over the last five years, FY 1996-2000, advertised highway projects in the MPO region equaled an average of approximately \$98.3 million per year.

The MPO dedicated approximately 90.8 % of these revenues to system maintenance and improvement, while obligating approximately 9.2% to system expansion. System maintenance and improvement includes infrastructure projects, such as bridge rehabilitation or highway reconstruction, and system enhancements, such as the construction of pedestrian or bicycle facilities or the signalization of intersections. System expansion includes the addition of capacity to the existing roadway network. It should be pointed out that the large percentage of funds that was obligated for system maintenance and improvement during FY 1996-2000 is, in part, a function of the

fact that except for the Central Artery Project no large multi-year capital projects were considered for funding in the MPO region. However, the effect of the Artery on the region's non-Artery program is beginning to lessen. In the current Transportation Improvement Program, the MPO has committed approximately 29.6% of its highway funding to expansion projects, while programming 70.4% for system maintenance and improvement.

Table 11-4 provides a breakdown of MPO highway advertisements for FY 1996-2000 and highway programming for FY 2001-2005.

Based upon the trends reflected in Table 11-4, the MPO has determined that the appropriate level of funding for capital maintenance and improvement should be maintained at no less than the recent trend of 70% of available funding, but should not be permitted to fall below the previous five-year average of \$89.2 million per year in any five-year period. At a minimum, this level of spending will require \$2.231 billion for system maintenance and improvements over the 25-year period of the Regional Transportation Plan.

TABLE 11-4
Highway Spending by Type
(\$, thousands)

	Maintenance & Improvement			System Expansion		Total
FY 1996	\$136,635	100%		\$0	0%	\$136,635
FY 1997	\$109,177	86.8%		\$16,646	13.2%	\$125,823
FY 1998	\$98,230	82.1%		\$21,483	17.9%	\$119,713
FY 1999	\$44,143	86.2%		\$7,079	13.8%	\$51,222
FY 2000	\$57,978	100%		\$0	0%	\$57,978
Five-Year Total	\$446,163	90.8%		\$45,208	9.2%	\$491,371
Five-Year Average	\$89,233	90.8%		\$9,042	9.2%	\$98,274
FY 2001	\$108,324	72.1%		\$41,814	27.9%	\$150,138
FY 2002	\$63,693	68.1%		\$29,828	31.9%	\$93,521
FY 2003	\$72,101	70.0%		\$30,901	30.0%	\$103,002
Three-Year Total	\$244,118	70.4%		\$102,543	29.6%	\$346,661
Three-Year Average	\$81,373	70.4%		\$34,181	29.6%	\$115,554
Eight-Year Total	\$690,282	82.4%		\$147,750	17.6%	\$838,032
Eight-Year Average	\$86,285	82.4%		\$18,469	17.6%	\$104,754

For the purpose of this Regional Transportation Plan, MassHighway has provided each MPO with a forecast of highway revenues for the next 25 years. This forecast projects revenues on a nominal (actual) dollar basis for the period of the Statewide Road and Bridge MOU and then makes long-range projections from 2006 through 2025 on a real (constant) dollar basis. However, costs with clearly identified payout schedules, such as commitments to the Route 3 North Project, are projected in nominal dollars throughout the plan.

Highway revenues are made up of federal-aid highway funds and state funds made available on an annual basis to MassHighway. Federal-aid highway funds have been projected by MassHighway based upon current apportionment levels, while state funds are based upon recent trends in non-Artery funding. In order to determine the overall level of highway funding available for the statewide road and bridge program, it is necessary to deduct certain funding programs off-the-top. These off-the-top programs include the Central Artery, other regions' mega-projects, the Route 3 North Project and statewide items (planning, extra work orders, and infrastructure maintenance). Table 11-5 on the following page shows MassHighway's projections of available highway revenues in five-year increments.

As shown in the table, the Boston MPO's share of the available Statewide Road and Bridge Pro-

gram equals approximately \$5.648 billion. However adjusting these projections to coincide with the first three years of TIP programming yields a slightly lower figure of \$5.559 billion. These revenues will be used to fund the MPO's system maintenance and improvement needs and selected expansion projects. Chapter 10 defines the recommended highway expansion program for the Regional Transportation Program. The projects included in the program are either currently programmed in the FY 2001-2006 Transportation Improvement Program (TIP) or are additional phases of projects begun under the TIP. The total cost of the highway expansion program is approximately \$218.6 million, the vast majority of which is programmed in the first 5 years of the RTP. This estimate excludes the \$640.0 million allocated for the Route 3 North Project since those costs are being taken off-the-top.

Table 11-6 compares revenues projected by MassHighway to identified MPO needs.

The table shows that the MPO will have sufficient funds to provide a level of system maintenance and improvement that well outpaces recent trends, will be able to fund all of its recommended capital expansion projects, and will have surplus funds available to either increase system maintenance and improvement beyond projected limits or program additional capacity expansions.

TABLE 11-6
Projected Highway Revenues Compared to Identified Needs
(\$, thousands)

	2001-2005	2006-2010	2011-2015	2016-2020	2021-2025	25-Yr. Total
Revenues	\$635,429	\$876,178	\$1,234,678	\$1,363,588	\$1,449,528	\$5,559,401
Maintenance & Improvement	\$434,429	\$525,825	\$776,775	\$867,012	\$927,170	\$3,542,945
Recommended Expansion	\$176,000	\$42,600	None Identified	None Identified	None Identified	\$218,600
Artery Payment	\$25,000	\$125,000	\$125,000	\$125,000	\$125,000	\$525,000
Surplus	\$0	\$182,753	\$332,903	\$371,576	\$397,358	\$1,222,856

Note: In 2001-2005, the percentage of non-Artery funds for maintenance and improvement does not meet the MPO's commitment to a 70% maintenance program, due to the need to maintain commitments made in the 2001-2006 Transportation Improvement Program.

TABLE 11-5
Projected Operations and Maintenance Costs of the Current Roadway System
(\$, thousands)

	2001-2005	2006-2010	2011-2015	2016-2020	2021-2025	25-Yr. Total
Federal						
Apportionment	\$2,652,589	\$2,623,680	\$2,623,680	\$2,623,680	\$2,623,680	\$13,147,309
Less: CA/T Needs	\$1,527,480	\$1,049,523	\$0	\$0	\$0	\$2,577,003
Less: Mega-Projects	\$273,920	\$17,920	\$0	\$0	\$0	\$291,840
Less: Rte. 3 North Needs	\$0	\$80,000	\$400,000	\$160,000	\$0	\$640,000
Less: Statewide Items						
Planning	\$75,000	\$75,000	\$75,000	\$75,000	\$75,000	\$375,000
Extra Work Orders	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$250,000
Infrastructure Maintenance	\$50,000	\$120,000	\$200,000	\$200,000	\$200,000	\$770,000
Available for SWRB Program	\$676,189	\$1,231,237	\$1,898,680	\$2,138,680	\$2,298,680	\$8,243,466
State Match for SWRB	\$169,047	\$307,809	\$474,670	\$534,670	\$574,670	\$2,060,867
Total SWRB Program	\$845,236	\$1,539,046	\$2,373,350	\$2,673,350	\$2,873,350	\$10,304,333
NFA Program	\$840,000	\$500,000	\$500,000	\$500,000	\$500,000	\$2,840,000
Total SWRB Program	\$1,685,236	\$2,039,046	\$2,873,350	\$3,173,350	\$3,373,350	\$13,144,333
Boston MPO MARPA Target	42.97%	42.97%	42.97%	42.97%	42.97%	42.97%
Total Boston MPO Program	\$724,146	\$876,178	\$1,234,678	\$1,363,588	\$1,449,528	\$5,648,118

THE REGIONAL PUBLIC TRANSPORTATION SYSTEM

In May 2000, the MBTA prepared the Forward Funding Finance Plan for submittal to the Federal Transit Administration and Wall Street bond rating agencies. The MPO has reviewed the finance plan and believes the projections contained in the plan are sound, if somewhat conservative. Therefore, the MPO has decided to base the long-range transit projections of the 2000-2025 Regional Transportation Plan on the Forward Funding Finance Plan. However, the MPO will be reviewing all of the assumptions made in the finance plan during development of the next RTP in Winter/Spring 2001 and may adjust one or more of the long-range financial assumptions if warranted.

In prior years, the MBTA, although nominally an independent authority, operated as a quasi-state agency for budgetary purposes. MBTA capital bonds were backed by the state and operating costs were primarily funded by annual appropriations. The forward funding legislation, which became effective July 1, 2000, dramatically altered this relationship. As part of the legislation, one cent of the state sales tax was dedicated to the MBTA and the MBTA was made solely responsible for funding its operating costs and its capital program. Henceforth, all bonds issued by the authority are no longer pledges of the state, but are instead backed by MBTA revenue. The Forward Funding Finance Plan was developed to demonstrate the MBTA's financial capacity to maintain and operate its system, while undertaking a capital bonding program.

The Forward Funding Finance Plan projects operation and maintenance costs on a nominal (actual) dollar basis through 2008 and then makes long-range projections from 2009 through 2030 on a real (constant) dollar basis, except that costs with clearly identified payout schedules, such as prior obligation debt service or lease payments, are projected in nominal dollars throughout the plan. This distinction is primarily based upon the fact that short-range (10 years or less) projections are usually much more valid than long-range forecasts. It is also somewhat reflective of the fact

that implicit in the MBTA's assuming fiscal responsibility for its own management is the need for costs and revenues to remain in equilibrium; even if the only options are to raise fares or reduce service. MBTA operation and maintenance costs are made up of prior obligation debt service (principal and interest payments on bonds outstanding on July 1, 2000), prior obligation lease payments, and standard operating expenses.

As mentioned earlier, prior to the enactment of the forward funding legislation, MBTA bonds were backed by the state. Upon the effective date of the legislation, however, contract payments from the state ceased and all outstanding debt became the responsibility of the MBTA. The projected debt service payments of these debts over the period of this RTP equal approximately \$6.137 billion.

Like debt service costs, obligations under prior lease agreements became the sole responsibility of the MBTA upon the effective date of the forward funding legislation. These lease payments are not related to capital equipment or rolling stock, but are primarily the result of lease-to-own arrangements for administrative or operating equipment. These lease payments, which end in 2013, total approximately \$163 million.

Standard operating expenses include administrative costs, wages and fringe benefits, products purchased for routine, non-capital maintenance, fuel and oil, and the costs of similar goods and services necessary to keep the regional public transportation system running. As part of its transition to forward funding, the MBTA is committed to instituting additional cost controls during the transitional period, 2002-2006. Consistent with recent trends, the Forward Funding Finance Plan projects that standard operating costs will grow by approximately 3% per year between 2001-2008, except that in the short-term such growth will be reduced by 2% per year. These estimates include operating expenses of the current system plus the South Boston Piers Transitway, the Silver Line, and Full Worcester Service. Over the life of this RTP, projected operating expenses are approximately \$20.756 billion.

Table 11-7 shows the projected operations and maintenance costs of the current MBTA system over the period of the 2000-2025 Regional Transportation Plan.

As with the costs shown in Table 11-7, the Forward Funding Finance Plan projects operation

atically withheld by the legislature from quarterly local aid distributions. The forward funding legislation established the total amount of assessments within the district at \$144.5 million for 2001. Generally speaking, assessments can grow at a rate of no more than 2.5% per year in accor-

TABLE 11-7
Projected Operations and Maintenance Costs of the Current MBTA System
(\$, thousands)

	2001-2005	2006-2010	2011-2015	2016-2020	2020-2025	25-Yr. Total
Prior Debt	\$1,517,000	\$1,474,000	\$1,323,000	\$1,021,000	\$802,000	\$6,137,000
Prior Lease	\$66,000	\$66,000	\$31,000	\$0	\$0	\$163,000
Expenses	\$3,851,000	\$4,170,000	\$4,245,000	\$4,245,000	\$4,245,000	\$20,756,000
Total	\$5,434,000	\$5,710,000	\$5,599,000	\$5,266,000	\$5,047,000	\$27,056,000

and maintenance revenues on a nominal (actual) dollar basis through 2008 and then makes long-range projections from 2009 through 2030 on a real (constant) dollar basis. The revenues available to fund the operation and maintenance costs come from the following sources: dedicated sales tax revenue, local assessments, federal-aid, and operating revenue.

As mentioned earlier, the forward funding legislation dedicated the proceeds of one cent of sales tax to the MBTA. The legislation also provided that for state fiscal year 2001, such revenue could not be less than \$645 million; additionally, the legislation provides for a 3% growth factor for this floor amount under certain circumstances. The Forward Funding Finance Plan estimates the MBTA's 2001 sales tax revenue at \$638 million, which would trigger the automatic increase contained in the legislation. For FY 2002-2008, the finance plan projects a sales tax growth of approximately 3% per year, well below recent and long-term trends. The projected sales tax revenue over the period of this RTP equals approximately \$19.110 billion.

In addition to the sales tax revenue, the MBTA is provided funding through local assessments in accordance with a statutory formula. Each community within the MBTA district is annually assessed a fee under this formula, which is auto-

dance with the limitations of Proposition 2 1/2; however, the forward funding legislation provided for a reduction in assessments back down to 2000 levels between 2001 and 2006. The Forward Funding Finance Plan provides this reduction, then assumes a 2.5% growth in 2007 and 2008. These assumptions yield \$3.555 billion over the life of the Regional Transportation Plan.

The final government source of operating revenue for the MBTA is federal-aid. In 1998, Congress eliminated federal operating assistance for large transit agencies such as the MBTA. However, TEA-21 does provide for a limited Preventative Maintenance Program, which can be used to fund traditional operating costs clearly associated with preventative maintenance. Since 1998, the MPO has annually programmed approximately \$6 million per year for preventative maintenance. The Forward Funding Finance Plan projects that this revenue will remain constant over the period of the RTP, providing approximately \$150 million.

In addition to revenues provided by government, the MBTA produces its own revenue stream through the imposition of fares and charges, as well as through the sale of property and the investment of income. The Forward Funding Finance Plan projects system revenue in the following categories: base revenue, revenue from ridership growth, revenue from fare increases,

and non-fare revenue. By definition, base revenue is a constant dollar estimate of the revenue generated by the current MBTA system. This revenue is approximately \$262 million per year, or \$6.550 billion from 2001 to 2025. Revenue from ridership growth is based on increased use of the current system and does not include revenue increases from any planned projects. The finance plan projects that ridership will grow by 2% per year except in years in which a fare increase is planned when there will be no growth. These estimates are somewhat more conservative than recent trends and will yield a 25-year total of

in 2004, and \$20 million in 2005. This growth would provide approximately \$473 million over 25-years.

Table 11-8 shows the projected operating revenue of the current MBTA system over the period of the 2000-2025 Regional Transportation Plan.

As shown earlier in Table 11-7, the projected operations and maintenance costs of the MBTA over the period of the RTP are \$27.056 billion, while Table 11-8 shows operating revenues of \$32.663 billion, leaving a projected surplus of approximately \$5.607 billion. These funds are

TABLE 11-8
Projected Operating Revenue of the Current MBTA System
(\$, thousands)

	2001-2005	2006-2010	2011-2015	2016-2020	2020-2025	25-Yr. Total
Sales Tax	\$3,358,000	\$3,887,000	\$3,955,000	\$3,955,000	\$3,955,000	\$19,110,000
Assessments	\$706,000	\$704,000	\$715,000	\$715,000	\$715,000	\$3,555,000
Federal-Aid	\$30,000	\$30,000	\$30,000	\$30,000	\$30,000	\$150,000
Operating Revenue (OR)						
Base	\$1,310,000	\$1,310,000	\$1,310,000	\$1,310,000	\$1,310,000	6,550,000
Growth	\$44,000	\$134,000	\$155,000	\$155,000	\$155,000	\$643,000
Fare Increase	\$262,000	\$480,000	\$480,000	\$480,000	\$480,000	\$2,182,000
Non-Fare	\$73,000	\$100,000	\$100,000	\$100,000	\$100,000	\$473,000
Subtotal of OR	\$1,689,000	\$2,024,000	2,045,000	\$2,045,000	\$2,045,000	\$9,848,000
Total	\$5,783,000	\$6,645,000	\$6,745,000	\$6,745,000	\$6,745,000	\$32,663,000

approximately \$643 million. In addition to revenue from ridership growth, the Forward Funding Finance Plan projects revenue from recent and assumed fare increases. The finance plan projects revenue from the recent 25% fare increase and also assumes a fare increase of 9.9% in 2003 and again in 2005. These fare increases provide \$ 2.182 billion over the life of the RTP. The final component of system revenue is non-fare revenue, such as that derived from parking, concession, advertisement, and the sale of surplus property. The MBTA has recently become more aggressive in its attempts to maximize this revenue, as evidenced by the recently awarded multi-million dollar, multi-year advertising contract. The Forward Funding Finance Plan projects that this revenue will grow by \$7 million in 2001, \$13 million in 2002, \$15 million in 2003, \$18 million

projected to be available to fund the MBTA's capital program as provided in this Regional Transportation Plan.

The MBTA capital program is composed of three funding programs: federal-aid, bond proceeds, and pay-as-you-go capital (PAYGO). The Forward Funding Finance Plan envisions the MBTA gradually transitioning from a capital program that relies primarily on bonding to one that requires little, if any, bond proceeds. Like the projections of operating costs and revenue, the Finance Plan projects capital costs on a nominal dollar basis through 2008 and then makes long-range projections from 2009 through 2030 on a real dollar basis, except that costs with clearly identified payout schedules, such as debt service payments, are projected in nominal dollars

throughout the plan. The Finance Plan projects a robust capital program from FY 2001 to 2008, ranging from a high of \$621.6 million in 2002 to a low of \$284.4 million in 2006. Thereafter, it projects level funding at \$254 million per year.

Federal-aid is projected based upon current trends under TEA-21 through 2008 and is level funded thereafter. During the remaining years of TEA-21, FY 2001-2003, federal-aid is projected at a relatively high level due to the continued expenditure of New Starts funds on the South Boston Piers Transitway. From 2004 to 2008 federal-aid is projected to grow in a similar fashion as it did under TEA-21. After 2008, such aid is flatlined at \$175 million per year. The total federal-aid projected to be available during the period of this RTP is \$4.470 billion.

After accounting for federal-aid, the MBTA capital program is divided between bond proceeds and PAYGO capital in a ratio sufficient to fund the program at predetermined levels. In the short-term, the Forward Funding Finance Plan relies on bond proceeds for a large portion of the capital program but gradually transitions to a limited bond program. Over the first 15 years of the RTP, the Finance Plan estimates that the MBTA will

issue bonds yielding approximately \$2.289 billion in net bond proceeds (face value less debt service reserve and cost of issuance). In the last 10 years of the RTP period the finance plan provides for no issuance of bonds and relies entirely on PAYGO capital and federal-aid to fund the program.

The level of PAYGO funding is primarily a function of other available funding sources and MBTA policy concerning the efficacy of maintaining, increasing, or limiting its bonded indebtedness. During 2001-2008, while bond issuances are rather large, PAYGO capital remains somewhat limited, due to the fact that most excess revenue is used to pay debt service on new bond issuances. Thereafter, PAYGO capital will grow to a level of \$82 million per year, sufficient to replace the issuance of additional bonded indebtedness.

Table 11-9 provides a breakdown of the MBTA capital program by source, while Table 11-10 shows the ability of the MBTA to fund its share of the capital program.

The surplus shown in Table 11-10 will be used to fund a legislatively required cash surplus, to pay the marginal operating costs of the projects in the

TABLE 11-9
The MBTA Capital Program by Source
(\$, thousands)

	2001-2005	2006-2010	2011-2015	2016-2020	2020-2025	25-Yr. Total
Federal-Aid	\$978,000	\$867,000	\$875,000	\$875,000	\$875,000	\$4,470,000
Bond Funds	\$1,555,000	\$551,000	\$183,000	\$0	\$0	\$2,289,000
PAYGO	\$19,000	\$148,000	\$212,000	\$410,000	\$410,000	\$1,199,000
Total	\$2,552,000	\$1,566,000	\$1,270,000	\$1,285,000	\$1,285,000	\$7,958,000

TABLE 11-10
Funding the Non-Federal Share of the MBTA Capital Program
(\$, thousands)

	2001-2005	2006-2010	2011-2015	2016-2020	2020-2025	25-Yr. Total
Excess Operating Revenue	\$349,000	\$935,000	\$1,146,000	\$1,479,000	\$1,698,000	\$5,607,000
Debt Service	\$298,000	\$730,000	\$883,000	\$928,000	\$930,000	\$3,769,000
PAYGO	\$19,000	\$148,000	\$212,000	\$410,000	\$410,000	\$1,199,000
Surplus	\$32,000	\$57,000	\$51,000	\$141,000	\$358,000	\$639,000

TABLE 11-11
The Transit Capital Program
(\$, thousands)

	2000-2005	2006-2010	2011-2015	2016-2020	2021-2025	25-Year Total
Capital Funds Available	\$2,552,000	\$1,567,000	\$1,270,000	\$1,285,000	\$1,285,000	\$7,959,000
Discretionary Surplus	\$0	\$0	\$0	\$89,000	\$308,000	\$397,000
70%*	\$1,636,000	\$1,097,000	\$889,000	\$900,000	\$900,000	5,422,000\$
30% Capital Program ¹	\$911,000	\$470,000	\$381,000	\$386,000	\$386,000	\$2,534,000
Transitway, Silver Line, ²						
Greenbush & Arborway ²	\$798, 000	\$214,000	\$143,000			
Silver Line, Phase B ³		\$225,000	\$150,000			
Green Line to Medford		\$132,000	\$88,000			
Blue/Red Connector		(\$101,000)	\$0	\$386,000	\$386,000	\$784,000
Capital Surplus/(Deficit)	\$113,000					

¹The funds listed in FY 2000-2025 for the 70%/30% split have been adjusted to back New Start funds out of the equation.

² The MBTA has proposed bus service to Arborway in lieu of extending the Green Line. This decision is pending further environmental review. This chart assumes the full cost of extending the Green Line, which is approximately \$59 million more than the bus option.

³The cost listed here is 50% of the total cost; the remaining costs will be funded with federal new start funds.

capital program, and to provide a liquidity fund for unexpected emergencies. The mandated cash surplus is approximately \$5 million per year and the marginal costs increase over time as projects come on line, so that the liquidity fund will not be built up until 2016 and beyond.

Chapter 10 defined the recommended transit capital program for the Regional Transportation Program. The projects included in the program are either already under construction or consti-

tute legal commitments of the MBTA. The total cost of the planned capital program is approximately \$1.888 billion, all of which is programmed in the first 10 years of the RTP.

Based upon historic trends, the Regional Transportation Plan assumes that over time the capital maintenance needs of the MBTA service will consume at least 70% of all available capital revenues, leaving a maximum of 30% for capital expansion projects. MBTA capital maintenance needs include infrastructure projects, such as signals and track upgrades, system enhancement projects, such as the installation of an automatic fare collection system, and accessibility projects, such as improvements necessary to comply with the Key Station Plan. Capital expansion projects, on the other hand, are projects that add new service to the system, such as the Silver Line. The actual allocation of funds between capital maintenance and expansion projects, while limited to the 70/30 split over the long-term, may vary somewhat in the short-term as necessary to meet the MBTA's legal commitments.

Table 11-11 on the previous page provides details of the planned implementation of the RTP's tran-

sit capital program and shows the financial capacity to fund the program.

In the previous sections, funding sources available for transportation projects in the Boston

region were discussed in the context of their use for a specific project or agency. The following section looks at these funding sources more generally, applying them to other uses where relevant. Other financing methods used in the Commonwealth for transportation projects will also be reviewed. Finally, the ensuing section provides information on



many of the financing options currently being employed in other regions of the country, while also assessing the potential for their use in the Boston region.

FUNDING SOURCES AND MECHANISMS

The Massachusetts transportation network is financed through a variety of revenue sources that may be broken down into three general categories: federal funding, state funding, and direct income. These sources are described briefly below.

Federal Funding

The Commonwealth receives federal appropriations for transportation purposes principally from the Federal Highway Administration, the Federal Transit Administration, the Federal Aviation Administration and the Federal Railroad Administration. Some of this funding is flexible and can be used to meet whatever transportation needs state decision makers identify, and the rest is specifically provided for particular transportation modes and projects. The federal gas tax is a primary source of this funding for transportation spending. It is currently set at 18.4 cents per gal-

lon. In FY 1997 \$ 939.6 million was collected in Massachusetts for the federal gas tax, and the state received approximately \$ 991.9 million back in the form of transportation funding.

State Funding

Gasoline Tax

This is the principal source of transportation taxes in the Commonwealth. The tax is currently 21¢ per gallon. The revenue from this tax is distributed to the Highway Fund, the General Fund and a variety of environmental funds. In 1999, the Commonwealth netted \$633 million from the gas tax. This means that for each cent of the gas tax, approximately \$30 million is raised. The Massachusetts Association of Regional Planning Agencies developed a formula by which the Boston MPO receives 42.97% of state money allocated to TIP spending. In FY2001 it is projected that \$602.2 million will be raised by the gas tax for highway spending statewide. Increased revenue from this source is politically difficult. Massachusetts law provided for an automatic increase in the gas tax that was intended to go into effect when the average price of gas reached \$1.75. As the price of oil increased in June of 2000 to the point where the automatic gas tax increase was inevitable, the legislature passed a law eliminating the increase.

Fees

Another source of revenue for the Commonwealth is in the form of fees charged to the owners and operators of motor vehicles. Massachusetts residents pay a license renewal fee every five years in order to renew their driver's license. This fee is \$33.75. The number of licensed drivers in the Commonwealth in 1996 was 4,355,000. Therefore, the license renewal fee raises an average of \$29,396,250 per year. Registration fees of

\$30 are also charged to motor vehicle owners in order to re-register their vehicles every two years. In 1996 there were an estimated 4,793,000 vehicles registered in the Commonwealth. With this



Building the Industriplex site

number of registered vehicles, registration fees bring in an average of \$71,895,000 per year. These fees collected by the Registry of Motor Vehicles are credited to the Commonwealth's Highway Fund. This fund is used to pay for projects eligible for funding as enhancement projects as described in

ISTEA, and for state highway improvements. Portions of the Highway Fund are also spent on the Metropolitan District Commission and the State Police Department.

Bond Proceeds

Massachusetts finances most of its share of the capital improvement program through bond sales. Debt service on these loans is then paid off through the General Fund and the Highway Fund. In order to borrow these funds, EOTC must prepare a Transportation Bond Bill every two years. Currently the Commonwealth has a \$1 billion bond cap for all state projects. In FY 2001, transportation received \$513 million of the \$1 billion of bond capacity. Chapter 90 funds, which pay for local transportation improvements, come from this bonding capacity. In recent years, Chapter 90 funds have amounted to between \$50 million and \$150 million in projects per year. The independent transportation authorities also have the ability to issue bonds to fund projects. Massport and MassPike bonds are not backed by the Commonwealth, as these authorities generate sufficient income to finance them. Beginning in July 2000, the MBTA no longer will issue bonds backed by the Commonwealth, but under its own credit rating.

Annual Appropriations

The Commonwealth has the option of providing an annual appropriation through the general operating budget to finance capital improvements, eliminating debt service by paying for projects with cash on hand rather than through a bond issuance. Until the completion of the Central Artery project, this annual appropriation will amount to \$100 million for the statewide road and bridge program. FY 2001 was an exception in that an additional \$66 million for the rehabilitation of stations on the Dorchester branch of the Red Line was also appropriated.

Sales Tax

As per the Massachusetts FY 2000 budget, the state's portion of funding for the MBTA will come from a portion of sales tax revenues. Beginning with July 2000 one-fifth of sales tax revenue, or one percent of sales of taxable goods, goes to the MBTA State and Local Contribution Fund. This fund replaces the annual end-of-year payment previously made by the state to cover MBTA expenses. A base revenue amount of \$645 million is guaranteed to the MBTA with a 3% increase per year for inflation.

Local Assessments

The Commonwealth has created an MBTA district consisting of 175 cities and towns. Municipalities within this district pay an assessment to the MBTA on an annual basis. The amount paid by each municipality varies according to population and level of service provided. Money from these assessments is also paid into the MBTA State and Local Contribution Fund (see Sales Tax). For FY 2001, the assessments will be \$145 million and subsequently reduced to \$136 million in FY 2006. After that it will increase by up to 2 1/2% per year.

Direct Income

Tolls

Massport collects tolls on all vehicles passing over the Tobin Bridge. In FY1998, toll revenue from the Tobin Bridge was \$12.486 million. The Massachusetts Turnpike Authority collects tolls on all vehicles passing through the three harbor tunnels and travelling along the Massachusetts Turnpike. The portion of the Massachusetts Turnpike within Route 128 and the three harbor tunnels are considered to be a part of the Metropolitan Highway System. In FY 1998, revenue from tolls on this part of Massachusetts Turnpike property was \$83.1 million. The Mass Pike west of Route 128 is considered to be the Western Turnpike. Only four exits on the Western Turnpike fall within the Boston MPO region. Toll revenue for the entire Western Turnpike was \$94.3 million in FY 1998.

Fares

The MBTA collects fares from riders on its subway, bus, and commuter rail network. In FY 1999 the MBTA Revenue from Transportation (fares on all rapid transit and bus service) was \$156,019,412. This does not include revenue from commuter rail operations, as this is a contracted service. Fares on the commuter rail are used to offset the cost of that contracted service.

Parking Fees, Advertising, Concessions, and Rent

In the MBTA budgeting system, revenues from these sources are grouped together under the heading Revenue from other Operations. In FY 1999 the MBTA revenue from this category was \$24.6 million. The MBTA collects parking fees from most of its commuter rail stations, many of its rapid transit stations and some bus depots. The MBTA also has an arrangement with Amtrak whereby all parking revenue from the Route 128 Amtrak/Commuter Rail station go to the MBTA. However, the MBTA will not realize any revenue from this facility until the debt incurred by the MBTA to build the garage has been paid off. In

FY 1998 Massport earned \$64.8 million from rentals and \$43.7 million from concessions. The Massachusetts Turnpike earned \$6.1 million in concessions and \$6.5 million in rentals in FY1998. These figures are for all of the Turnpike's highways.

Non-Operating Revenue

The primary source of non-operating revenue is income earned on investments by the different transportation agencies. The sale of property is also an example of non-operating revenue. In FY1999 the MBTA earned \$5.264 million from investment income and the sale of property. In FY1998 the Massachusetts Turnpike Authority earned \$62.3 million from investment income. In FY1998 Massport earned \$15 million in investment income and \$577,000 from the sale of assets.

FINANCING OPTIONS FOR MASSACHUSETTS

The following sections describe potential alternatives for financing transportation in Massachusetts. The Commonwealth has been pursuing some of these mechanisms for some time, while others may not be presently feasible. However, all options should be considered in planning for long term transportation financing.

Private Sector Financing, Fees and Payments

These financing methods seek to form partnerships with the private sector in order to fund transportation and other infrastructure projects. Each of them is best suited to be administered by different levels of government: the Commonwealth, MPO agencies, and local governments.

MPO Agency Options:

Lease-to-own

This approach is feasible when the new facility is projected to generate enough revenue to provide investors with a competitive return. If this rev-

enue is not sufficient then public funds can pay for a portion of the cost. Public agencies can also lease a facility from a private builder. This is the situation at the Wellington Station garage, which the MBTA leases from a private developer.

Status: In use

Leasing/Selling Development Rights

In this option, the air, ground, or subsurface parcels associated with a highway or transit line are sold or leased. Due to the high costs of such construction, developers are generally only interested when strong real estate markets or high density locations exist. The proposed office tower development over South Station is an example of this method, as are the existing Prudential Center and Copley Place developments.

Status: In use

Leasing/Selling Surplus Property

Public agencies can generate revenue by selling or leasing surplus property to the private sector. It is generally not legal for an agency to acquire more land through eminent domain than is actually needed and then to lease or sell it. This strategy can be applicable, however, if the purchase of land for advanced right-of-way acquisition (land banking) is the reason for an eventual surplus of property. MassPike used this strategy with excess land in Weston that was recently developed by Harvard Pilgrim Health.

Status: In use

Design-Build-Operate

This approach allows both the design and construction aspects and initial operation of a transportation project to be handled by one entity. The results are greater efficiencies for the company charged with carrying out the project, which translate into cost and time savings for the public agencies funding the project. MassHighway is currently in the process of employing this method on the widening of Route 3 north of Boston.

Status: In use

Grant Anticipation Notes (GANs)

This method is similar to revenue bond issues. Instead of future revenues being earmarked for their repayment, GANs are paid for with future federal and state funding. The guidelines for the use of GANs was introduced as part of ISTEA in 1991. The Central Artery project was funded in part with money raised by issuing GANs.

Status: In use

MassHighway's Public/Private Development Unit (PPDU)

This approach is currently employed by MassHighway. Although not a source of revenue, the PPDU is an example of the Commonwealth's successful attempts to forge a working partnership between the public and private sectors. The mission of PPDU is to balance the goals of preserving and enhancing the capacity of the state highway system and encouraging economic development throughout the Commonwealth. PPDU coordinates MassHighway's response to private development proposals subject to the Massachusetts Environmental Policy Act (MEPA) that require state highway access permits and asserts jurisdiction over only those private development projects which actually abut state highway. In this way, the environmental review process has become more predictable for both private developers and MassHighway alike. In conjunction with other MassHighway divisions, PPDU reviews the traffic impacts of a project, identifies appropriate and equitable traffic mitigation measures, and submits comments to the Commonwealth's Executive Office of Environmental Affairs' MEPA unit, which coordinates state level environmental review among permitting agencies. PPDU's coordinating role has ensured that developers are treated in a consistent manner across the Commonwealth. Negotiations with developers yield traffic mitigation packages that focus on the provision of actual products. MassHighway refrains from collecting traffic and impact fees because the agency does not have a mechanism for ensuring that any fees would be directed towards highway improvements in the

area in which a development will have impacts on the state highway system.

Status: In use

Congestion Pricing

This approach is similar to charging tolls for the use of highways. The difference is that the toll varies in response to either expected or observed levels of congestion on the roadway. Although congestion pricing has been used on only a couple of roadways in the United States, it has been implemented in several others. The lowest cost method for implementing congestion pricing would be a simple toll that varied based on the time of day. In peak periods where congestion is a problem, toll rates would increase to discourage travel. The lower rates in off-peak hours would encourage people to alter their travel behavior, so that excess capacity in off-peak hours is better utilized. The more advanced variation of congestion pricing would be able to respond to actual levels of congestion on a real-time basis. In order for a truly responsive system to be feasible, an electronic method of toll collecting (similar to Fast Lane) would have to be in place on the roadway in question. Then, toll rates would fluctuate in an effort to maintain a constant level of traffic. Rates increase as congestion increases and are lowered when the roadway is congestion-free. The use of electronic toll collection would allow a multitude of toll rates to be used and changes in the rate could be made as frequently as needed. A system this responsive is problematic because it requires all users of the road to have a transponder or other device to allow for electronic collection.

Status: Difficult to implement

Air Rights Development

As the value of land in the core of Boston MPO region continues to increase, the incentives grow for using this approach to raise revenue for transportation projects. Air rights are the claim that property owner's have on the space above their property. The Commonwealth owns significant

portions of land in the core of the metropolitan area in the form of railroad and highway rights of way. The MPO agency that specifically owns the right of way can negotiate with a developer on a price for the sale of the air rights above the right of way. Due to the high cost of building decks over a highway or railroad capable of carrying large-scale developments, this approach is best used in areas where the value of land is extremely high, or where no other land may be available. Examples of this approach over highways include the Prudential Center and Copley Place in Boston and the Sheraton Hotel in Newton. All three of these developments are on air rights above the Massachusetts Turnpike. Negotiations have been ongoing for the construction of an office tower on air rights above the railroad tracks in South Station, as well as at several additional Turnpike sites. The Central Artery surface, although primarily dedicated to open space, will also be the site of several air rights developments, the sale of which will contribute to paying for the cost of the Artery project.

Status: In use

State Government Options:

Tax Increment (Tax Allocation) Financing

This method funds public improvements in a designated area with projected increases in property tax revenues that are likely to result from the improvements. These projected increases are usually then allocated to back a bond. The tax rate is not increased, and there are no reductions to the amount of tax revenues that go into other funds. Tax increment financing is appropriate for site-specific projects such as highway interchanges and street improvements. State enabling legislation is required to use this method.

Status: Needs legislative action

Local Government Options:

Incentive Zoning (for In-kind Improvements)

This method relaxes a restrictive zoning law for a developer in return for inclusion of a publicly-

benefit in the development. Incentive zoning is voluntary for developers and is a way to provide in-kind improvements rather than the direct financing of roads. An example would be additional development height for a developer who will construct roads that will benefit the public as well as their development.

Status: In use

Negotiated Investments (for Contributions)

These investments differ from incentive zoning in that the developer contributes funding for a public improvement rather than the actual development of the improvement itself. This is also generally done in exchange for variances to existing land use regulations. This strategy is most suitable for locations that are very desirable and where competition for development is keen.

Status: In use

Dedications and Exactions (Required Fees)

These financing tools require contributions without the provision of zoning incentives. Dedications require land or public facilities provision as a condition for development approval, while exactions require cash payments. These policies ensure provision of public improvements at the same time as the development occurs. They should also be directly related to the development project.

Status: In use

Special District Zoning (Special Planning Districts)

This zoning mechanism is a variation on dedications. Special planning districts are designated due to unique characteristics such as historic importance or strong redevelopment pressure. The master plan for such a district can require developers to provide transportation-related improvements. Unlike incentive zoning, special planning districts generally require compliance. New developments in special districts in New York

City have often been required to provide subway station improvements in neighboring stations.

Status: Possible

Business Improvement Districts (BIDs)

These districts are designated areas encompassing the properties that are expected to benefit from a public improvement. The property owners of an area vote to create a BID. The property owners then pay a mandatory annual assessment on top of property taxes. These funds are then used to pay for increased security, improved sanitation, and transportation and pedestrian improvements, in addition to others. Business owners in Downtown Crossing are currently in the process of creating a Business Improvement District. The difficulty facing this proposed BID, as well as others, is that they must be approved by the legislature. BIDs have been politically challenging in the Commonwealth. The Downtown Crossing BID is facing political opposition by the police unions which are opposed to increased reliance on private security forces.

Status: Politically difficult

Impact Fees

This approach allows municipalities to charge developers a fee commensurate with the cost of mitigating congestion-related impacts of their development. They can also be charged in cases of other environmental impacts. These fees are currently illegal in the Commonwealth. The Massachusetts court system has judged impact fees to be a type of tax, since their payment is not optional in cases where there is an impact. Towns are not allowed to levy taxes without the consent of the legislature. Since there is no evidence that the legislature would move to make impact fees legal in the near future, this option is unlikely to be available to MPO communities.

Status: Need legislative action

Institutional and Intergovernmental Approaches

In addition to the private funding mechanisms outlined above, there are also intergovernmental approaches that have begun to be implemented in other states. The cross-jurisdictional nature of these options makes them feasible primarily for states to administer.

Regional Tax Base Sharing

In this system, all governments within a given region share a percentage of the regionwide growth in the tax base. Each local government calculates the difference in assessed value of all commercial and industrial property in its jurisdiction between the current year and the base year. A percentage of this is distributed region-wide according to a formula based on population and inversely related to its relative fiscal capacity. In effect, each commercial and industrial property is taxed at both the area-wide average for the proportion dedicated to the region, and at the local rate for everything else. This reduces inter-community inequities and competition for development, thus stimulating a more efficient pattern of land use and development. This option is politically difficult in Massachusetts, a state with a nearly 400 hundred year tradition of local governmental control over land use. In recent years, several county governments have been dissolved, removing the only level of government, albeit a weak one, between the municipality and the state. Although municipalities have always been in Massachusetts, as elsewhere, creations of the state, population-wise the majority now lives in the dozens of suburban municipalities that ring Boston. There is little hope that individual municipalities, particularly ones that would effectively have to donate part of their tax revenue to towns with poorer tax bases, would make the decision to enter into a regional tax-base sharing arrangement.

Status: Politically difficult, will require regional level political backing

Local Government Banks

State bond banks have been created to issue bonds on behalf of local governments, and to issue debt for which the proceeds are then used to purchase local bond issues. These bond banks receive a rating one category below the state's regular bond rating. Since local governments pay higher interest on privately borrowed funds, the state bond bank allows them to assume the bond bank's higher rating. This reduces the cost of the debt issue and thus of the project it funds.

Status: Need legislative action

State Infrastructure Banks

These banks are specifically intended to fund infrastructure construction and rehabilitation. Initial funds are obtained by issuing bonds, obtaining state appropriations, and drawing on unused state revenues. A revolving loan fund generates the next generation of income. Loans from the State Infrastructure Bank in Arizona are helping to speed the completion of the Price Freeway in the Phoenix metropolitan area.

Status: Need legislative action

CONCLUSION

The 2000-2025 Regional Transportation Plan is financially constrained to reasonable projections of currently available revenues. In fact, the MPO will be reassessing certain projections made in the RTP to determine whether additional revenues should be projected. Nevertheless, even given the somewhat conservative projections used in this financial plan the MPO has shown the financial capacity to adequately fund the current system while constructing the projects recommended in Chapter 10.



CHAPTER

12

ENVIRONMENTAL JUSTICE MEASURES

Title VI of the Civil Rights Act prohibits discrimination on the basis of race, color, or ethnic origin in the provision of transportation benefits and in the imposition of adverse impacts. Building on Title VI, Executive Order 12898, dated February 11, 1994, requires each federal agency to achieve environmental justice by identifying and addressing any disproportionately high and adverse human health or environmental effects, including interrelated social and economic effects, of its programs, policies, and activities on minority or low-income populations. On April 15, 1997, USDOT issued its Final Order to Address Environmental Justice in Minority Populations and Low Income Populations. Among other provisions, the Order requires programming and planning activities to:

- include explicit consideration of the effects of transportation decisions on minority and low-income populations;
- provide meaningful opportunities for public involvement by members of minority populations and low-income populations;
- gather, where relevant, appropriate and practical, demographic information (race, color, national origin, and income level) on the populations served or affected by transportation decisions; and
- minimize or mitigate any adverse impact on minority or low-income populations.

The Executive Order and Title VI of the 1964 Civil Rights Act require this Regional Transportation Plan to specifically address the needs and concerns of protected communities, both in terms of benefits received and impacts imposed. This requirement has implications for both procedural and substantive issues. Procedurally, the Boston MPO must identify Title VI populations and low-income populations and design methods to reach those populations. Substantively, MPO decisions must provide equitable treatment for minority and low-income populations when compared to the benefits provided to and the burdens imposed upon non-minority and non-low-income populations.

The Boston MPO has developed a plan of action to address the specific requirements of the Executive Order and to ensure that all identified populations are treated equitably by the planning process and by the decisions made as a result of that process. This plan of action takes a three-pronged approach to addressing environmental justice.

- First, the MPO has expanded and continues to expand its public outreach efforts to low-income communities and to minority communities.
- Second, the MPO is developing measures to test the achievement of environmental justice in our planning documents, with specific emphasis being placed on the current development of the Regional Transportation Plan.
- Third, the MPO views its environmental justice efforts as a continuing process to refine the analytical tools necessary to measure the achievement of environmental justice in transportation.

EXPANDED PUBLIC OUTREACH TO TARGETED COMMUNITIES

One tangible effect of the MPO's environmental justice initiative is its recent efforts to involve diverse communities in the update of the Regional Transportation Plan. As part of these efforts, the MPO sought advice and information from various advocacy groups serving the needs of minority and low-income residents. The MPO adopted many of the recommendations received from community representatives for conducting outreach for the RTP. Namely, the outreach meetings sought greater involvement from targeted communities by:

- selecting locations accessible by public transportation,
- choosing venues in or near low-income communities,
- involving representatives from diverse stakeholders,
- expanding the contact list to include numerous community-based organizations and non-profit groups, and
- using appropriate media to announce meetings (announcements in transit vehicles, direct mail, advertisements in local and ethnic newspapers).

All community meetings for the Regional Transportation Plan included discussions of environmental justice issues. Table 12-1 provides a list of environmental justice meetings the MPO initiated or attended this year. While environmental justice was not necessarily the primary focus of each meeting, it appeared as an agenda item or was raised as a topic of discussion at each.

These meetings resulted, among other things, in the development of a preliminary definition of "environmental justice," and in the development of indicators to measure the achievement of environmental justice.

Equally as important as these tangible results, however, was the development of a rapport between the MPO and community-based organizations. The operation of the Environmental Justice Ad Hoc Committee has, for the first time, allowed for a direct give-and-take between individual MPO members and



Community meeting

representatives of community groups in a non-confrontational, consensus-building format.

TABLE 12-1
Environmental Justice Meetings on the RTP

The following is a list of meetings the MPO initiated or attended this year. While environmental justice was not necessarily the primary focus of each meeting. Environmental justice either appeared as an agenda item or a topic of discussion.

Date	Meeting	Place	Type
January 14	Establish environmental justice as an issue to include in the Regional Transportation Plan	Boston, Mass.	Meeting with MPO and MAPC staff
February 2-3	AASHTO workshop on environmental justice	Arlington, VA	Informational workshop
February 3, 8, 15	Discuss ways to conduct outreach to target minority and low-income communities	Boston, Mass.	Meeting with community-based organizations
March 21	Environmental justice forum	Boston, Mass.	Transportation Plan Public Meeting
March 23	Community Meeting to discuss the Transportation Plan	Lynn, Mass.	Transportation Plan Public Meeting
March 28	Community Meeting to discuss the Transportation Plan	Framingham, Mass.	Transportation Plan Public Meeting
March 29	Community Meeting to discuss the Transportation Plan	Boston, Mass.	Transportation Plan Public Meeting
April 6	Community Meeting to discuss the Transportation Plan	Quincy, Mass.	Transportation Plan Public Meeting
June 1	Community Meeting to discuss the Transportation Plan	Roxbury, Mass.	Transportation Plan Public Meeting
July 20	Workshop on the regional travel model	Boston, Mass.	Meeting with community-based organizations
September 20	Public meeting about the MPO process	Framingham, Mass.	Federal certification review meeting
September 21	Public meeting about the MPO process	Roxbury, Mass.	Federal certification review meeting
October 10	Develop environmental justice indicators	Roxbury, Mass.	Meeting with community-based organizations
October 23, November 6, 16	Develop environmental justice indicators	Boston, Mass.	Environmental Justice Ad Hoc Committee

Providing an understandable definition of environmental justice allows the MPO to create consensus among diverse stakeholders. Without agreement on the meaning and reach of environmental justice, the MPO cannot effectively evaluate its policies and projects for their environmental justice implications. The MPO developed the following definition for the 2000-2025 Regional Transportation Plan based on comments received in public meetings over the course of the year:

“Environmental justice” requires the MPO to examine the allocation of benefits and burdens, historically, currently, and in the planned future to ensure that minority and low-income communities are treated equitably in the provision of transportation services and projects.”

The MPO began a process early this year to identify knowledgeable stakeholders representing various communities throughout the region. These stakeholders have proven to be an invaluable resource to communicate the transportation needs and interests that the Regional Transportation Plan should consider. Through public meetings, often held in targeted neighborhoods, the MPO has received assistance in defining environmental justice and developing short-range indicators that measure existing conditions related to environmental justice. Following the initial analyses in the RTP, the MPO will continue to work with community-based organizations to expand its efforts to additional analyses that may require the gathering of new or updated data.

MEASURES TO TEST THE ACHIEVEMENT OF ENVIRONMENTAL JUSTICE

The first step in the process of developing environmental justice measures was the development of geographic data sets to identify low-income and minority communities. To this end, early in the planning process the MPO created three maps showing census tracts with low-income populations, minority populations, and transit-dependent (zero vehicle) households. Once these maps and data sets were developed, the MPO took them out to the public meetings on the Regional Trans-

portation Plan to help facilitate the discussion of environmental justice.

These meetings, particularly the three meetings of the Environmental Justice Ad Hoc Committee, were invaluable to the MPO in its work on the issue of environmental justice. For the 2000-2025 Regional Transportation Plan, the Environmental Justice Ad Hoc Committee concentrated its efforts on the development of measures for which data is currently available. Future meetings will focus on the development of additional measures that may require the gathering of data by the MPO or its member agencies. The measures adopted for this RTP by the MPO in consultation with the Ad Hoc Committee include measurements of transit access, frequency of transit service, transit crowding, transit vehicle assignment, bridge conditions, and MPO capital highway investments.

To measure transit access, the MPO overlaid the MBTA bus system and rapid transit system on maps showing low-income and minority census tracts. For the purposes of the Regional Transportation Plan, a low-income census tract is one where the median income is equal to 75% or less of the median income for the MPO region. A minority census tract is defined as one where the percentage of minority residents is higher than the percentage of minorities residing in the MPO region. These maps, which are reproduced on the following pages, show that over 70% of low-income and minority census tracts are located within one-quarter mile of available bus or rapid transit service, while less than 15% of non-low-income and non-minority tracts are located within walking distance of these services. These maps, however, only tell a limited part of the story; an additional issue that needs to be addressed is whether the transit access that is being provided is meaningful for the populations being served.

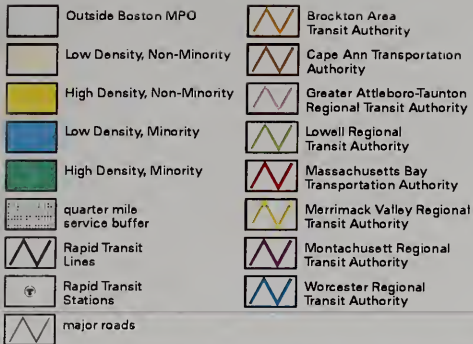
In response to comments received during the public review period, the MPO has disaggregated the analysis of MBTA rapid transit service from the MBTA bus service. The analysis shows that for MBTA rapid transit service, 19.5% of the total area for high-density minority tracts are within a

MBTA Bus and Transit Service

Census Tracts with Concentrations of
Minority Population

Census Tracts with High Population Density

Legend



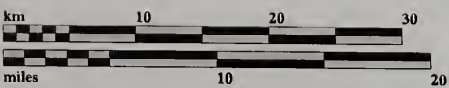
WPO Region Population Profile

Census Tracts	Total Area	Area Inside 1/4 Mile Buffer	Percentage of Total Area Inside 1/4 Mile
Low Density	16.28	9.17	56.3%
Minority	1256.99	96.49	7.7%
High Density	41.66	36.19	86.9%
Minority Tracts	89.99	69.53	77.3%
Low Density Total	1273.27	105.66	8.3%
High Density Total	131.65	105.72	80.3%
Minority Total	57.94	45.36	78.3%
Non-Minority Total	1346.98	168.02	12.3%
TOTAL	1404.92	211.38	15.0%

Notes:

- (1) This graphic was prepared with data collected for, and using criteria defined for, the 1994 and 1999 Title VI assessments for the MBTA. The service buffer is defined around MBTA rapid transit stations and bus routes.
- (2) High density refers to Census Tracts with a population density of greater than 5,000 persons per square mile.
- (3) Minority population is defined as all persons except non-Hispanic whites. In 1990, the population of the MBTA region was 15.9% minority. Minority tracts are defined as those with a minority population percentage greater than that of the MBTA region (15.9%).

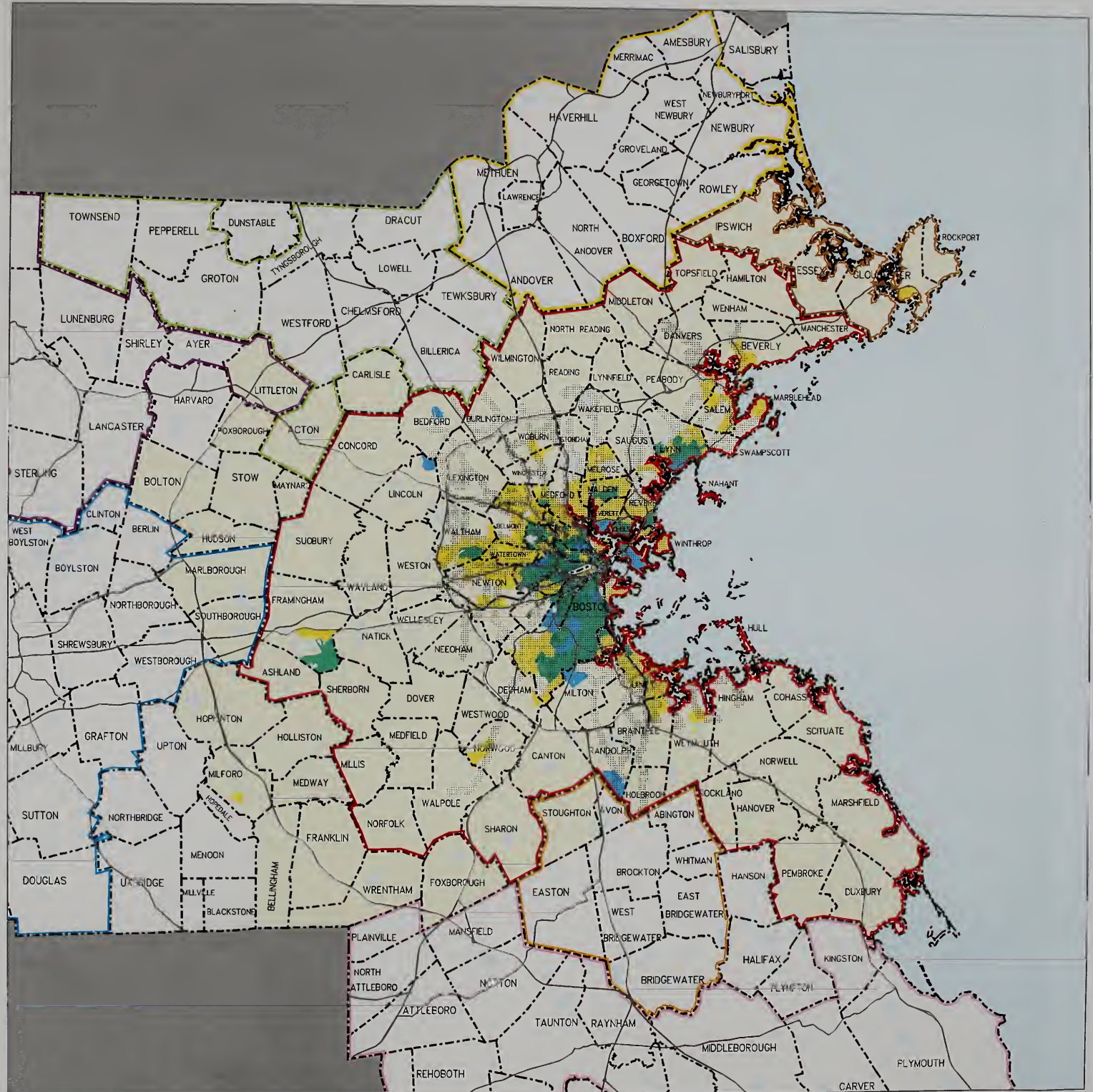
Note: Census tracts with a population density of less than 5,000 persons per square mile are classified as minority tracts according to this standard.



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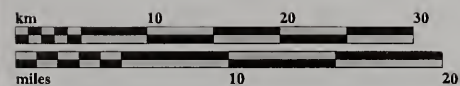
Low Income Census Tracts:
1989 Median Household Income Less Than
75% of MPO Median of \$40,000

	Outside Boston MPO		Greater Attleboro-Taunton Regional Transit Authority
	Median Inc. < = 75% of Regional Median		Lowell Regional Transit Authority
	Median Inc. > 75% of Regional Median		Massachusetts Bay Transportation Authority
	quarter mile service buffer		Merrimack Valley Regional Transit Authority
	Rapid Transit Lines		Montachusett Regional Transit Authority
	Rapid Transit Stations		Worcester Regional Transit Authority
	major roads		
	Brockton Area Transit Authority		
	Cape Ann Transportation Authority		

MPO Region Household Income Profile			
Census Tracts	Total Area	Area Inside 1/4 Mile Buffer	Percentage of Total Area Inside 1/4 Mile
Lower Income	30.88	22.67	73.42
Higher Income	1374.05	188.72	13.72
TOTAL	1404.93	211.39	15.02

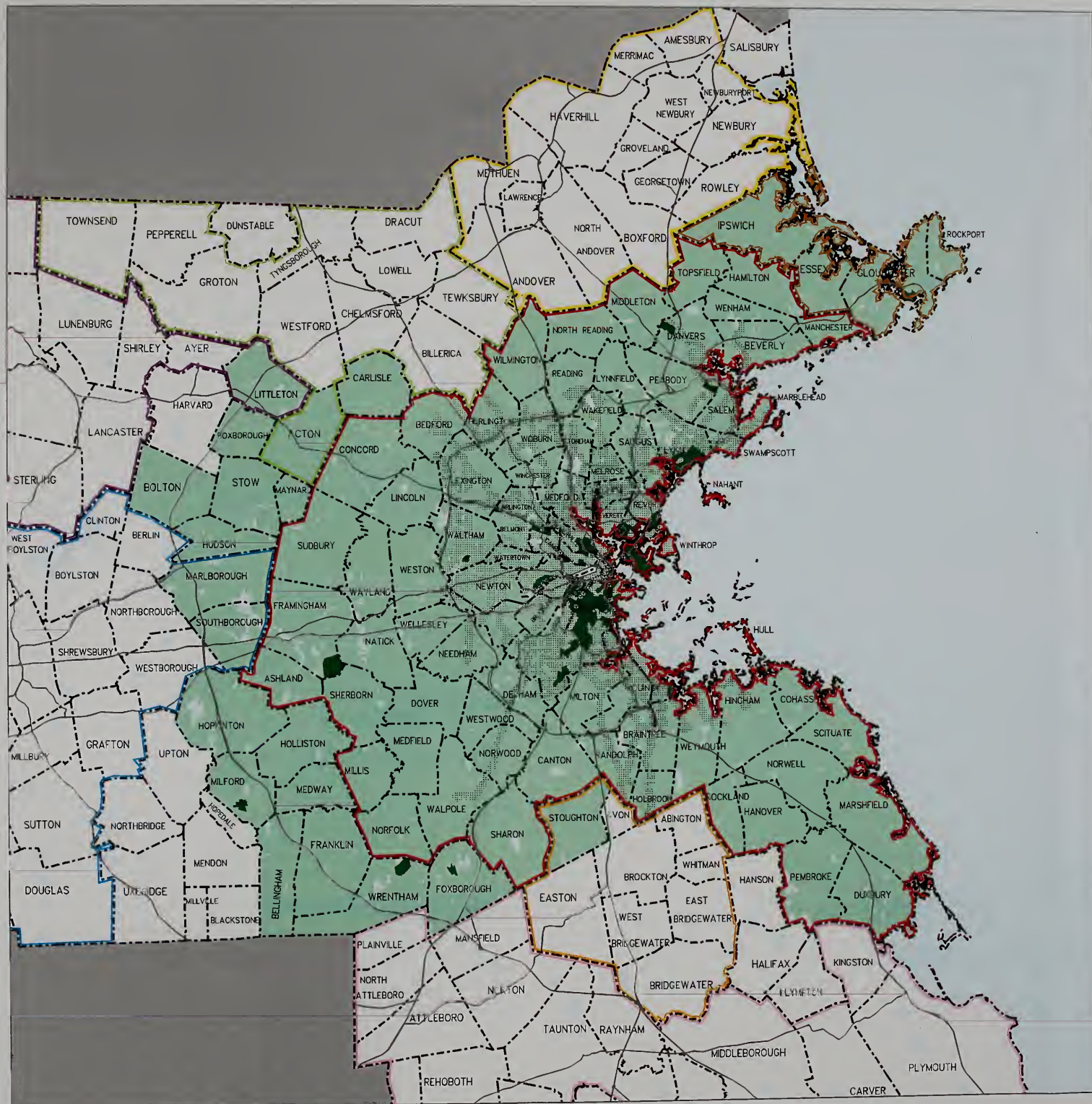
Notes:

- (1) This graphic was prepared with data collected for, and using criteria defined for, the 1994 and 1999 Title VI assessments for the MBTA. The service buffer is defined around MBTA rapid transit stations and bus routes.
- (2) Median household income in 1989 was approximately \$40,000 for the WPO region. Census tracts with a median income of no more than 75% of the WPO region median are considered to be low income tracts.
- (3) This graphic portrays only MBTA scheduled bus and rapid transit routes. The WPO is also served by other regional transit authorities as well as other local bus service.



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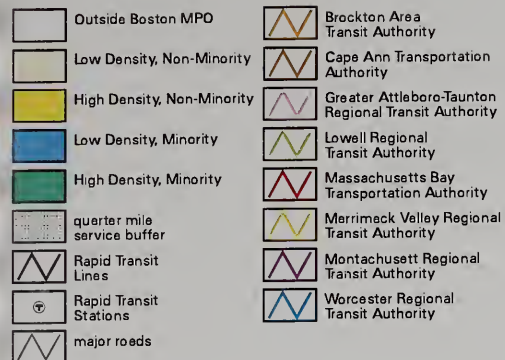


MBTA Rapid Transit Service

Census Tracts with Concentrations of Minority Population

Census Tracts with High Population Density

Legend



Census Tracts	Total Area	Area Inside 1/4 Mile Rapid Transit Service Buffer	Percentage of Total Area Inside 1/4 Mile
Low Density	16.28	0.84	5.2%
Minority	1256.99	2.09	0.2%
Non-Minority			
High Density	41.66	8.43	19.5%
Minority Tracts	89.99	5.01	5.6%
Non-Minority Tracts			
Low Density Total	1273.27	2.93	0.2%
High Density Total	131.65	13.14	10.0%
Minority Total	57.94	8.97	15.3%
Non-Minority Total	1346.98	7.10	0.5%
TOTAL	1404.92	16.07	1.1%

Notes:

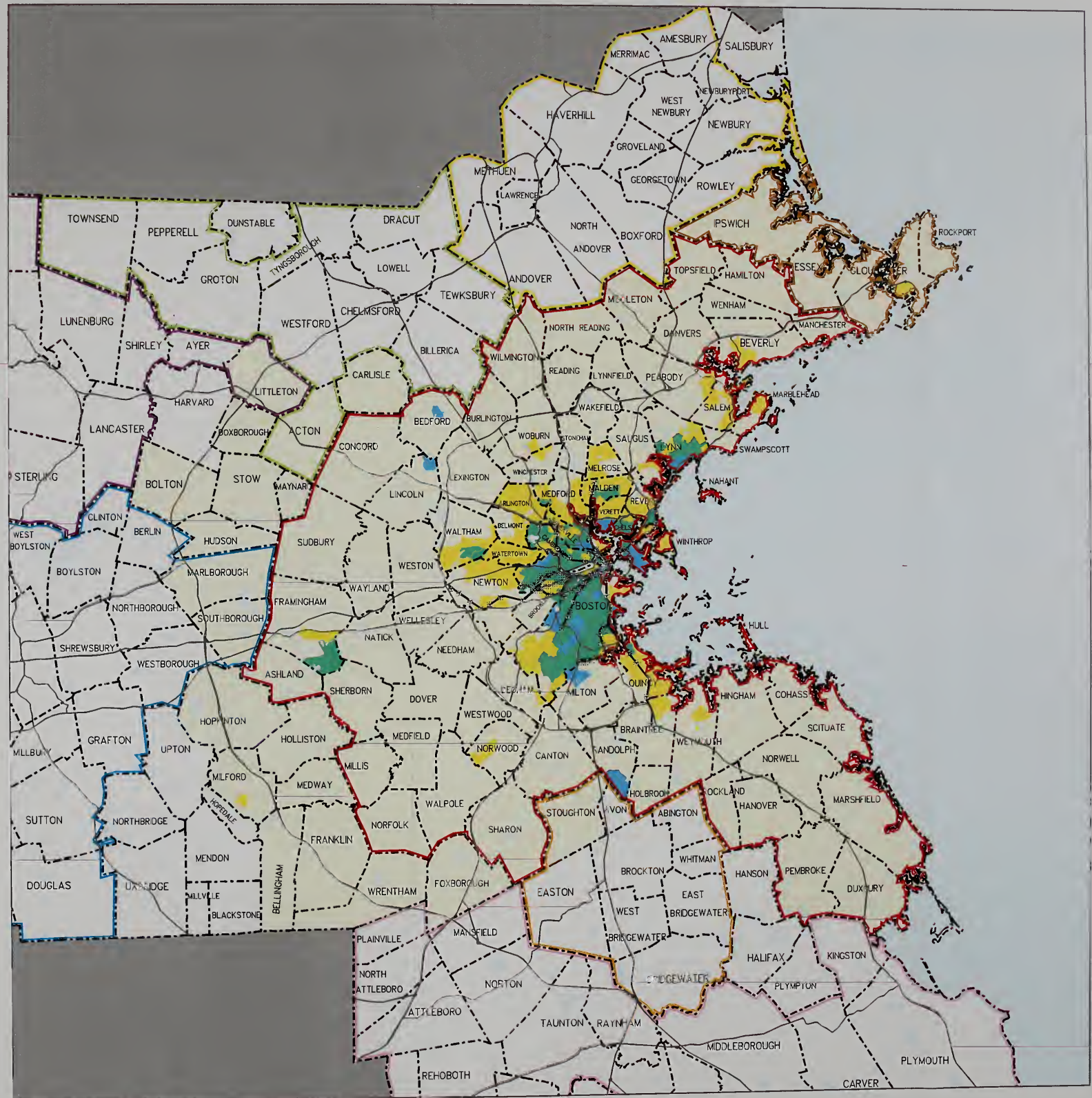
- (1) This graphic was prepared with data collected for, and using criteria defined for, the 1994 and 1999 Title VI assessments for the MBTA. The service buffer is defined around MBTA rapid transit stations and bus routes.
- (2) High density refers to Census tracts with a population density of greater than 5,000 persons per square mile.
- (3) Minority population is defined as all persons except non-Hispanic whites. In 1990, the population of the MBTA region was 15.9% minority. Minority tracts are defined as those with a minority population percentage greater than that of the MBTA region (78 cities and towns). No Boston MPO Census tracts outside of the 78 MBTA cities and towns are classified as minority tracts according to this standard.



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quarter mile of a rapid transit stop. This is compared to 5.6% of the total area for high-density non-minority tracts. The analysis for low income census tracts shows that 15% of the total area of low income census tracts are within a quarter-mile of an MBTA rapid transit station. Less than 1% of the total area of higher income census tracts is within a quarter-mile of an MBTA rapid transit station. The MPO will continue to work with the public to further analyze this data.

Many of the region's minority and low-income households have limited access to an automobile and must, therefore, rely on the transit system to perform the daily chores of life, while most of the non-minority and non-low income households have access to one or more private vehicles. Given this fact, equitable treatment in the provision of transportation services requires more than simply providing transit service; such service must be designed to serve the needs of the targeted communities. The MPO has begun to examine the relationship between transit access and major employment centers and it appears that overall the MBTA does a relatively good job of providing access to employment, particularly in the urban core. However, those workers who have late night or early morning shifts or those who commute to low-density suburban locations are less able to depend upon the transit system to meet their needs. Additional data will be gathered on this issue in the coming months prior to the adoption of the 2001 RTP to examine whether service barriers, such as the need for frequent transfers, significantly limit this vital service. In addition, there do appear to be gaps in service between census tracts located outside the core and radially located job sites. Ways to measure and address these gaps will also be addressed in more detail in the coming months.

To measure frequency of service, the MPO examined scheduled headways for minority and low-income bus routes compared to non-minority and non-low-income bus routes. For purposes of measuring Title VI compliance, the Federal Transit Administration defines a minority bus route as any bus route that has more than one-third of its mileage within a minority census tract. The MPO

has adopted a modified version of this definition, which excludes express bus routes that travel through but do not stop in minority areas. The MPO has also adopted this definition for use in defining low-income routes.

As shown in Table 12-2, scheduled headways for minority and low-income bus routes are more frequent than those for non-minority and non-low-income bus routes. For each time period during the weekday and on the weekend, the percentage of routes providing frequent or very frequent bus service is greater on minority and low-income routes than it is on non-minority or non-low-income routes. Because of differences in schedules and actual service, the MPO is now collecting data to be able to analyze actual headways as opposed to scheduled headways. The MPO staff expects to have preliminary data to share with the public in the early spring.

The measurement of transit crowding can be achieved in at least two ways—via the load factor (passengers/seats) or via the crowding factor (passengers/vehicle capacity). The first measure is fairly straightforward and simply measures the number of passengers that are forced to stand as a surrogate for crowded capacity. The second measure is somewhat more complicated and attempts to measure crowding based on comfortable capacity, which is often greater than seating capacity. The crowding factor assumes that differing services (bus, transit, commuter rail) are designed with differing capacity standards; for example, no one expects the Green Line to operate at seating capacity only. In fact, if it did the service would not be economically viable. Both of these measures were presented to the Environmental Justice Ad Hoc Committee. For the most part, the advocacy group representatives on the committee seemed to prefer load factor as the measure of transit crowding. Indeed, the argument was made that accepting differing vehicle capacity standards as a given might amount to a backdoor acceptance of inequitable treatment.

Based upon these concerns, the MPO has opted to use load factor in the 2000-2025 Regional Transportation Plan, but will continue to pursue this

TABLE 12-2
Scheduled Headways for MBTA Bus Routes

SCHEDULED HEADWAYS - BUS and TRACKLESS TROLLEY SERVICE					
AM PEAK - 7:00 AM - 9:00 AM					
Percentage of Routes with the following headways					
Census Tracts/ Type of Community	Very Frequent (0 - 15 min.)	Frequent (16 - 30 min.)	Less Frequent (31 - 60 min.)	Infrequent (60 + min.)	Not Operating
Minority	46.58	46.58	4.11	1.37	1.37
Non-minority	28.42	53.68	11.58	5.26	1.05
Low-income	46.51	48.84	2.33	2.33	0.00
Non low-income	32.80	51.20	10.40	4.00	1.60
MID DAY - 9:00 AM - 4:00 PM					
Minority	20.55	49.32	24.66	0.00	5.48
Non-minority	5.26	24.21	43.16	5.26	22.11
Low-income	25.58	41.86	23.26	0.00	9.30
Non low-income	7.20	32.80	39.20	4.00	16.80
PM PEAK - 4:00 PM - 6:00 PM					
Minority	42.47	47.95	6.85	0.00	2.74
Non-minority	28.42	47.37	14.74	4.21	5.26
Low-income	41.86	46.51	9.30	0.00	2.33
Non low-income	32.00	48.00	12.00	3.20	4.80
EVENING - 6:00 PM - end of service					
Minority	6.85	30.14	32.88	0.00	30.14
Non-minority	1.05	7.37	31.58	5.26	54.74
Low-income	9.30	30.23	30.23	0.00	30.23
Non low-income	1.60	12.80	32.80	4.00	48.80
SATURDAY					
Minority	17.81	42.47	24.66	0.00	15.07
Non-minority	3.16	26.32	34.74	5.26	30.53
Low-income	20.93	44.19	18.60	0.00	16.28
Non low-income	5.60	29.60	34.40	4.00	26.40
SUNDAY					
Minority	12.33	16.44	41.10	0.00	30.14
Non-minority	1.05	4.21	32.63	5.26	56.84
Low-income	13.95	16.28	39.53	0.00	30.23
Non low-income	3.20	7.20	35.20	4.00	50.40

issue at future meetings of the Ad Hoc Committee.

The measurement of load factors reveals that minority and low-income bus routes are by-and-large more crowded than non-minority and non-low-income bus routes. For example, the average load factor during the peak half-hour on a minority route is 108.77%, which means that on average 3-4 people are standing, and on a low-income route it's 112.18%, which translates to 4-5 people standing. Table 12-3 provides a breakdown of load factors for the MBTA system.

The final transit measure that was endorsed by the Environmental Justice Ad Hoc Committee is a measurement of vehicle assignment. This measurement is an attempt to determine whether newer and more comfortable vehicles are routinely assigned to non-minority and non-low-income routes. As reflected in Table 12-4, the average bus used on a minority and low-income route is newer than the average bus used on a non-minority or non-low-income route. It is also true that a higher percentage of the newer buses used on minority and low-income routes are equipped with air conditioning. Additional investigation is required to ascertain if maintenance practices

TABLE 12-3
Load Factors on the MBTA System

VEHICLE LOAD - BUS AND TRACKLESS TROLLEY				
Load Factor = No. Passengers / vehicle seat				
Percentage of routes with the indicated load factor				
Average Census Tracts/ Type of Community	Average Load Factor	1-8 Persons Standing	9-16 Persons Standing	More Than 16 Persons Standing
Minority	108.77	58.67	30.67	9.33
Non-minority	99.01	45.74	20.21	6.38
Low-income	112.18	59.09	31.82	11.36
Non low-income	99.65	48.80	22.40	6.40
Overall (average)	103.88			

COMMUTER RAIL		RAPID TRANSIT (RAIL)	
Rail Line	Average Load Factor	Rail Line	Average Load Factor
Fairmount	29.43	Green Line/Boston College (B)	168.48
Fitchburg	88.76	Green Line/Cleveland Circle (C)	204.57
Franklin	95.72	Green Line/Riverside (D)	209.24
Haverhill	80.94	Green Line/Heath Street (E)	132.88
Lowell	95.47	Green Line/Central Subway	178.42
Middleborough	109.04	Red Line/Mattapan High Speed Line	154.15
Needham	86.08	Red Line/Ashmont Branch	153.50
Newburyport	73.60	Red Line/Braintree Branch	236.93
Plymouth/Kingston	124.25	Red Line/Cambridge	176.25
Providence	113.53	Orange Line	183.50
Rockport	97.10	Blue Line	204.37
Stoughton	76.40		
Worcester	81.97		
Overall (average)	88.30		

TABLE 12-4
Crowd Factors on the MBTA System

VEHICLE CROWD - BUS AND TRACKLESS TROLLEY				
Crowd Factor = No. Passengers / vehicle capacity				
Percentage of routes with the indicated crowd factor				
Average Census Tracts/ Type of Community	Average Crowd Factor	% With Crowd Factor > 75%	% With Crowd Factor > 90%	% With Crowd Factor > 100%
Minority	77.69	56.00	28.00	9.33
Non-minority	70.72	42.55	18.09	6.38
Low-income	80.13	56.82	31.82	11.36
Non low-income	71.18	45.60	19.20	6.40
Overall (average)	74.20	48.52	22.49	7.69

COMMUTER RAIL		RAPID TRANSIT (RAIL)	
Rail Line	Average Crowd Factor	Rail Line	Average Crowd Factor
Fairmount	29.43	Green Line/Boston College (B)	70.45
Fitchburg	88.76	Green Line/Cleveland Circle (C)	85.55
Franklin	95.72	Green Line/Riverside (D)	87.50
Haverhill	80.94	Green Line/Heath Street (E)	55.57
Lowell	95.47	Green Line/Central Subway	74.61
Middleborough	109.04	Red Line/Mattapan High Speed Line	70.07
Needham	86.08	Red Line/Ashmont Branch	45.15
Newburyport	73.60	Red Line/Braintree Branch	69.69
Plymouth/Kingston	124.25	Red Line/Cambridge	51.84
Providence	113.53	Orange Line	81.87
Rockport	97.10	Blue Line	90.35
Stoughton	76.40		
Worcester	81.97		
Overall (average)	88.30		

TABLE 12-5
Average Age and Comfort of MBTA Vehicles

VEHICLE ASSIGNMENT - BUS and TRACKLESS TROLLEY		
Census Tracts/ Type of Community	Average Age (years)	Vehicles with Air Conditioning (% of Vehicles by community)
Minority	7.99	81.33
Non-minority	10.98	62.25
Low-income	7.50	84.12
Non low-income	10.31	66.71
Overall (average)	9.29	73.06
Standard Useful Life	12-15	

VEHICLE ASSIGNMENT - COMMUTER RAIL		
Rail Line	Average Age	Vehicles with Air Conditioning (% of Vehicles by community)
Fairmount	10.16	100.00
Fitchburg	11.61	100.00
Franklin	9.81	100.00
Haverhill	11.78	100.00
Lowell	11.68	100.00
Middleborough	5.75	100.00
Needham	10.24	100.00
Newburyport/Rockport	11.80	100.00
Plymouth/ Kingston	5.19	100.00
Providence	9.5	100.00
Stoughton	9.70	100.00
Worcester	9.57	100.00
Overall (average)	9.75	100.00
Standard Useful Life	25	

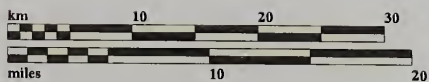
VEHICLE ASSIGNMENT - RAPID TRANSIT (Rail)		
Rail Line	Average Age	Vehicles with Air Conditioning (% of Vehicles by community)
Green Line/Boston College (B)	N/A	100.00
Green Line/Cleveland Circle (C)	N/A	100.00
Green Line/Riverside (D)	N/A	100.00
Green Line/Heath Street (E)	N/A	100.00
Green Line/Central Subway	N/A	100.00
Red Line/Mattapan	N/A	N/A
High Speed Line	55.00	0.00
Red Line/Ashmont Branch	12.50	100.00
Red Line/Braintree Branch	15.80	100.00
Red Line/Overall	14.20	100.00
Orange Line	19.00	100.00
Blue Line	21.00	100.00
Standard Useful Life	25	

Low Income Census Tracts:
1989 Median Household Income Less Than
75% of MPO Median of \$40,000

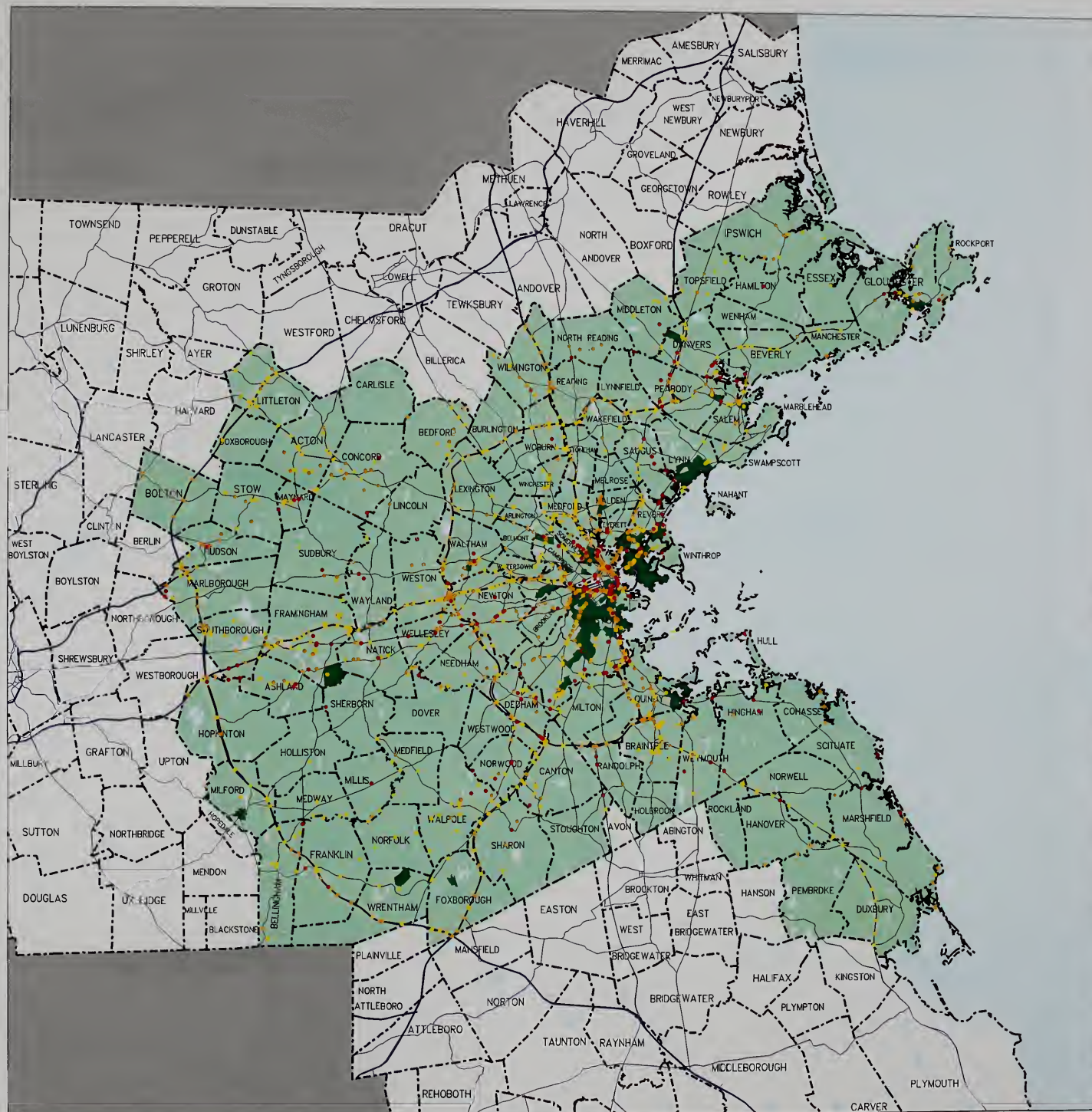
-  Outside Boston MPO
-  Median Inc. \leq 75% of Regional Median
-  Median Inc. $>$ 75% of Regional Median
-  interstate highways
-  other major roads
-  Structurally Deficient Bridge
-  Functionally Obsolete Bridge
-  Bridge Meets Standards

Census Tracts	Structurally Deficient Bridges	Functionally Obsolete Bridges	Bridge Needs Standards	Total Bridges
Lower Income	19 (12.5%)	63 (41.4%)	70 (46.1%)	152
Higher Income	150 (10.7%)	398 (31.8%)	705 (56.3%)	1253
TOTAL	169 (12.0%)	461 (32.8%)	775 (55.2%)	1405

Census Tracts	Structurally Deficient Bridges	Functionally Obsolete Bridges	Bridge Needs Standards	Total Bridges
Lower Income	17 (11.6%)	59 (40.4%)	70 (47.9%)	146
Higher Income	146 (12.0%)	384 (31.4%)	691 (56.6%)	1221
TOTAL	163 (11.9%)	443 (32.4%)	761 (55.7%)	1367



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truly result in equal or unequal measures of comfort.

In addition to the above transit measures, the MPO and the Environmental Justice Ad Hoc Committee have developed two environmental justice measures relating to bridges and highways. The first measure is an examination of the region's bridges by location and status. The second is a review of recent MPO funding decisions made in recent Transportation Improvement Programs. These measures are an attempt to discover whether highway infrastructure in low-income and minority areas is being ignored in favor of the infrastructure needs of non-minority and non-low-income areas.

The examination of bridge conditions by location reveals that a lower percentage of bridges in minority and low-income areas meet state and federal standards. However, the discrepancy between these percentages is not related to safety concerns and is solely an issue of function. A higher percentage of bridges in minority and low-income areas are functionally obsolete—they are forced to carry more traffic than they were designed for. It should also be noted that because the number of bridges found in minority and low-income areas is so small compared to the number of bridges located in non-minority and non-low-income areas, the reconstruction of a relatively low number of bridges would significantly reduce the existing discrepancy. A map of bridge conditions by location appears on the next page.

A review of MPO highway programming decisions in recent TIPs (1996-2000) reveals that the vast majority of highway funds programmed by the MPO have been allocated to non-minority non-low-income areas. Of the approximately \$491.4 million of non-Artery highway projects advertised in the Boston MPO region, less than 20% has been allocated for use on projects located in minority or low-income areas. This level of programming is not to be unexpected, however, given the large geographic area covered

by the MPO and the concentration of minority and low-income persons in a relatively small subset of that area. Further thought needs to be expended on these issues to identify true measures of environmental justice.

ANTICIPATED WORK FOR THE COMING FISCAL YEAR

The MPO's involvement with issues of environmental justice is very much a work in progress. Even after work is completed on this Regional Transportation Plan, the MPO intends to continue to improve and expand its environmental justice initiatives. Work will begin immediately on the refinement of the measures contained in this RTP and the development of additional measures for use in the 2001 Regional Transportation Plan, which is expected to be completed in the Summer of 2001.

This work will continue to involve the members of the Environmental Justice Ad Hoc Committee. Some of the issues the MPO and the committee will focus on in the coming months include:

- what additional data needs to be collected to properly interpret existing measures;
- how to identify and measure the needs of persons who are not currently served by the system;
- how to better measure the equity investment of transportation infrastructure in minority and non-minority neighborhoods;
- how to more adequately measure the relationship between highway spending and environmental justice;
- how to perform and normalize cross-modal measurements;
- how to measure efficiency and efficacy of service; and
- how to expand the involvement of low-income and minority communities.

CONCLUSION

The Boston MPO's measurements of environmental justice have shown some initial successes, as well as some failings. The MPO has an extensive regional public transportation system that provides a high degree of access to minority and low-income riders. Additionally, on average minority and low-income bus riders have more frequent service and ride on newer vehicles. However, these riders also are slightly more likely to be forced to stand for all or part of their ride. Similarly, that portion of the region's bridge system that is located within minority or low-income areas is, on average slightly less likely to have structural defects but more likely to be functionally obsolete.

One product of the greater awareness of environmental justice can be seen in the actions of one of the MPOs state agency members. MBTA recently instituted two new revenue policies as a result of public comment given during the MBTA's fare increase hearings. The two policies are meant to reduce some of the burden for lower-income riders of the Fall 2000 MBTA fare increase. A free bus-to-bus transfer policy for those riders who must use more than one bus to reach their destination began in December 2000. It also has introduced weekly "Combo" transit passes to assist those lower-income riders for whom the cost of a monthly "Combo" pass may be excessive.

These bare facts only tell part of the story, however, because if environmental justice is to have any meaning it must result in the improvement of the quality of life for the targeted communities. Issues, such as on-time performance of transit, the provision of transit amenities, the possible need for longer or differing hours of operation, and the provision of service to new and growing employment centers need to be addressed as the MPO moves forward with its short-range and long-range planning initiatives. The MPO has not undertaken this review simply to comply in some formulaic way with the dictates of federal law; rather, the MPO is committed to the concept of environmental justice. As we move forward in our attempt to better define, measure, and achieve environmental justice, the MPO will continue to consult with community-based advocacy groups and listen to the diverse voices within the region. The MPO is committed to having this process continue and will build upon the successful model of using the Environmental Justice Ad Hoc Committee for input and guidance. The goal is to continue real dialogue and build consensus on future transportation planning.



CHAPTER

13

AIR QUALITY CONFORMITY DETERMINATION

INTRODUCTION

This document presents information and analyses for the latest air quality conformity determination for the 2000 Transportation Plan of the Boston Metropolitan Planning Organization (MPO), as required by Federal Regulations 40 CFR Part 93 and the Massachusetts Conformity Regulations (310 CMR 60.03). The information and analyses include: regulatory framework, conformity requirements, planning assumptions, mobile source emissions budgets, and conformity consultation procedures.

Background

Eastern Massachusetts has historically been classified as serious nonattainment for the 1-hour ozone standard. With this nonattainment classification, the 1990 Clean Air Act Amendments (CAAA) require the Commonwealth to reduce its emissions of volatile organic compounds (VOC) and nitrogen oxides (NO_x). VOC and NO_x react photochemically in the presence of sunlight to form ozone. The 1-hour ozone standard established by the United States Environmental Protection Agency (EPA) is 0.12 parts per million averaged over one hour. The nonattainment classification means that this standard is not being met.

In July 1997 the EPA proposed a new 8-hour standard for ozone. The new 8-hour ozone standard is 0.08 parts per million averaged over eight hours. The new 8-hour standard was to become effective in September 1997 and would provide increased protection to the public. EPA also promulgated regulations providing that the revocation of the 1-hour ozone standard would occur in areas that had met the standard. This was done to facilitate continuity in public health protection during the transition to the new 8-hour standard. Monitoring data showed that Eastern Massachusetts had met the 1-hour standard from 1996 to 1998 and in June 1999, the 1-hour standard was revoked.

However in October 1999, due to a recent ruling of a US District Court of Appeals, EPA proposed to reinstate the 1-hour ozone standard. In the ruling, the court remanded the 8-hour ozone standard and curtailed EPA's authority to enforce it. The effectiveness of the 8-hour standard served as the underlying basis for the revocation of the 1-hour standard. The one hour reinstatement was finalized on July 20, 2000, but is not effective in Eastern Massachusetts until January 16, 2001. The ozone conformity analysis for Eastern Massachusetts is being performed in conjunction with the development of this new regional transportation plan, so conformity for the one hour standard will be in place by January 2001.

The Boston MPO is also required to provide a conformity determination for carbon monoxide (CO) for the moderate CO nonattainment area of Waltham and for the nine cities and towns in the Boston CO maintenance area. The two standards for CO are 9 parts per million averaged over an eight hour period and 35 parts per million averaged over one hour. With the CO nonattainment classification, the City of Waltham is required to reduce its emissions of carbon monoxide from 1990 levels.

In December of 1994, the Massachusetts Department of Environmental Protection (DEP) submitted a request to redesignate the carbon monoxide nonattainment areas of Boston, Cambridge, Chelsea, Everett, Malden, Medford, Quincy, Revere, and Somerville to attainment status. DEP submitted this documentation to the United States Environmental Protection Agency (EPA) in December of 1994. In that submission, DEP established a CO emission budget for the nine cities in the Boston nonattainment area. EPA approved this SIP submission in the January 30, 1996 Federal Register and was effective on April 1, 1996. These nine communities are now designated as attainment (meeting the standards) for CO; however, they remain in maintenance status for the next twenty years. This means that the Commonwealth is required to submit conformity determinations over the next twenty years to show that CO emissions are within the standards for this area. In August of 1997, a technical cor-

rection was made to the SIP submittal revising the projections of CO emissions in the maintenance area. The Boston MPO must provide a conformity determination showing that emissions of CO associated with this TIP do not exceed these projections of CO set in the SIP.

Conformity Regulations

The Clean Air Act Amendments (CAAA) revised the requirements for designated nonattainment Metropolitan Planning Organizations (MPO) to perform conformity determinations by nonattainment area for their Transportation Plans and Transportation Improvement Programs (TIP). Section 176 of the CAAA defines conformity to a State Implementation Plan (SIP) to mean conformity to the plan's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards (NAAQS) and achieving expeditious attainment of the standards. The Boston MPO must certify that all activities outlined in the 2000 Transportation Plan and conformity determination:

- will not cause or contribute to any new violation of any standard in any area;
- will not increase the frequency or severity of any existing violation of any standard in any area; and
- will not delay the timely attainment of any standard or any required interim emission reductions or other milestones in any area.

The EPA issued final conformity regulations in the November 24, 1993 Federal Register and Massachusetts DEP issued new conformity regulations effective December 30, 1994. They set forth requirements for determining conformity of Transportation Plans, Transportation Improvement Programs, and individual projects. The federal conformity regulations were amended on August 15, 1997. The requirements of the conformity analysis are summarized below and will be explained in detail in this conformity determination:

Conformity Criteria

- Horizon years
- Latest planning assumptions
- Latest emission model used
- Timely implementation of transportation control measures (TCM)
- Conformity in accordance with the consultation procedures and SIP revisions
- Public Participation Procedures
- Financially Constrained Document

Procedures for Determining Regional Transportation Emissions

The Conformity Test

- Consistent with emission budgets set forth in SIP
- Contribute to reductions in CO nonattainment areas

This Plan and Conformity Determination will be showing consistency with the VOC and NO_x mobile source emission budget in Eastern Massachusetts and in the nine cities and towns in the Boston CO maintenance area. The baseline vs. action test or the less than 1990 emissions test will be required in the City of Waltham CO nonattainment area because there has been no budget set for that area.

CONFORMITY DETERMINATION CRITERIA

This conformity determination has been prepared in accordance with 40 CFR Part 93 - Transportation Conformity Rule Amendments: Flexibility and Streamlining; Final Rule. It shows that the 2000 Transportation Plan for the Boston MPO has

been prepared following all the guidelines and requirements of the rule.

Horizon Year Requirements

Horizon years for regional model analysis have been established following 40 CFR 93.106(a) of the Federal Conformity Regulations. The years for which the model was run are shown below:

- 1990 – Milestone Year – This year has been established as the base year in the SIP for calculation of emission reductions of CO.
- 1995 – Base Year – This year has been established as the base year for existing conditions for the Transportation Plan.
- 2003 – Analysis Year – VOC and NO_x emissions budgets set for this year.
- 2025 – Analysis Year – last forecast year of transportation plan.



VOC and NO_x emissions in the Boston MPO area for the years 1997, 2010 and 2020 were determined through interpolation of the modeled data. CO emissions in the Boston area and Waltham CO nonattainment area for the years 2005, 2010 and 2020 were also determined through interpolation of the modeled data.

Latest Planning Assumptions

Population, Employment and Traffic Assumptions

Section 93.110 of the Federal Conformity Regulations outlines the requirements for the most recent planning assumptions that must be in place at the time of the conformity determination. Assumptions must be derived from the estimates of cur-

rent and future population, employment, travel, and congestion most recently developed by the MPO. Analyses for the Boston MPO 2000 Transportation Plan and Conformity Determination are based on U.S. Census data and information obtained from the Metropolitan Area Planning Council and Massachusetts Highway Department. The following is a list of the sources of data used for the 2000 Plan analysis:

- **Population:** Summary Tape File 1B Data for Massachusetts from the 1990 U.S. Census of Population and Housing. Updated to 1995 at the city and town level with 1995 estimates prepared by the Massachusetts Institute for Social and Economic Research (MISER).
- **Employment:** Town-level employment from Massachusetts Department of Employment and Training, "Employment and Wages in Massachusetts' Cities and Towns 1986-1995," September, 1996.

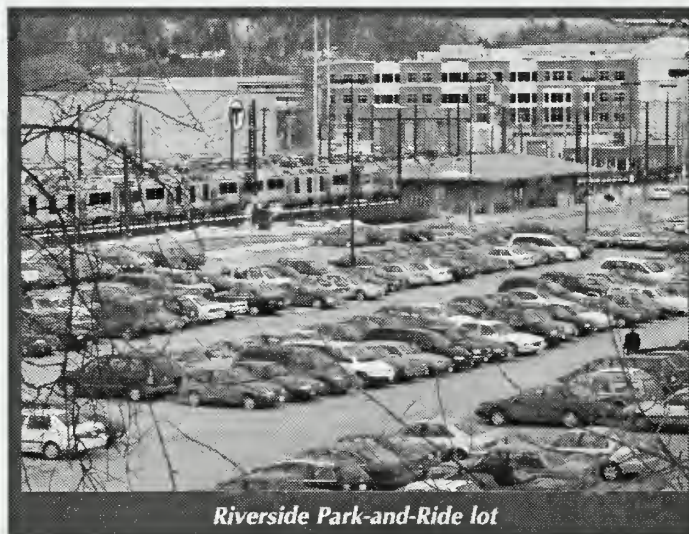
Estimates of employment below town level from factors based upon the Regional Planning Study Site-Level Employment Data Base.

- **Population Forecasts:** Metropolitan Area Planning Council, Population Forecasts, May, 2000.
- **Employment Forecasts:** Metropolitan Area Planning Council, Employment Forecasts, May, 2000.
- **Households:** Summary Tape File 1B data for Massachusetts from the 1990 U.S. Census for Population and Housing. Updated to 1995 based upon changes in population between 1990 and 1995.

- **Household Forecasts:** Metropolitan Area Planning Council, Household Forecasts, May, 2000.
- **Household Sizes:** Summary Tape File 3A data for Massachusetts from the 1990 U.S. Census of Population and Housing.
- **Vehicle Ownership:** Summary Tape File 3A data for Massachusetts from the 1990 U.S. Census of Population and Housing was used in estimating and calibrating the CTPS Vehicle Ownership Model. Estimates after 1995 produced by application of the Vehicle Ownership Model.
- **Traffic Volumes:** Massachusetts Highway Department, "1995 Traffic Volumes for the Commonwealth of Massachusetts", September, 1996.

Additional traffic counts taken by the Massachusetts Highway Department and the Central Transportation Planning Staff.

- **Project-Level Data:** Obtained from the responsible implementing agency.



Transit Operating Policy Assumptions

Transit service assumptions used in ridership modeling of the 2000 Plan were based on 1993/1994 MBTA service. The model calibration was performed using the following:

- MBTA's Ridership and Service Statistics published in March 1993.
- The Central Artery/Third Harbor Tunnel Regional Transit Mitigation Program prepared by Vanasse Hangen Brusslin for the MBTA in September, 1991.

The operating policies and assumed transit ridership have not changed since the conformity determination prepared for the original 1997 Transportation Plan Update and its 1999 Re-Determination of Air Quality Conformity and the 2001-2006 TIP Amendment which was just completed.

Emission Inventory Assumptions

This 2000 Transportation Plan will be determining conformity with the Massachusetts State Implementation Plan (SIP) mobile source emission budgets submitted in March of 1997 and October of 1998 for VOC and NO_x and in December of 1994 and later revised in August of 1997 for carbon monoxide in the nine cities and towns in the Boston CO maintenance area. The VOC mobile source emission budget for 2003 for the Massachusetts Eastern Nonattainment Area has been set at 117.118 tons per summer day and the 2003 mobile source budget for NO_x is 243.328 tons per summer day.

The Boston MPO VOC and NO_x emissions will be combined with the following MPOs/RPAs to show conformity with the SIP in the Eastern Ozone Nonattainment Area:

- Cape Cod Commission
- Central Massachusetts Regional Planning Commission
- Merrimack Valley Planning Commission
- Montachusett Regional Planning Commission
- Northern Middlesex Council of Governments
- Old Colony Planning Council
- Southeastern Regional Planning and Economical Development District
- Martha's Vineyard Commission

- Nantucket Planning and Economical Development Commission

CO emission projections have been set for the nine cities in the Boston area reclassified to attainment. An emissions attainment inventory for CO of 501.53 tons per winter day was established



for all sources of CO emissions (mobile sources, industrial sources and all other sources of CO) for the redesignation year 1993. Of that 501.53 tons, 305.43 tons per winter day were allocated for mobile sources. In addition to the attainment year inventory, EPA

required that emission projections for every five years through 2010 also be developed to allow for increases or decreases for all the sources of CO emissions. This is to ensure that the combination of all CO emissions will not exceed the total 501.53 tons per winter day in the future. The mobile source emission projections have been set as shown below. Emissions from the nine cities and towns in Boston area cannot exceed the amount in the last year of the maintenance plan (2010).

- 266.13 tons per winter day for 1995
- 226.0 tons per winter day for 2000
- 217.53 tons per winter day for 2005
- 228.33 tons per winter day for 2010

The Massachusetts Highway Department (MassHighway), on behalf of the Executive Office of Transportation and Construction (EOTC) compiled the results from all the MPOs in the Eastern ozone nonattainment area. The air quality analysis has been finalized for all of the MPOs and the EOTC has made the final con-

formity determinations for the ozone nonattainment area.

Latest Emission Model

Emission factors used for calculating emission changes were determined using MOBILE 5A-H (November 1995), the model used by DEP in

determining the mobile source budget. Emission factors for motor vehicles are specific to each model year, pollutant type, temperature and travel speed. MOBILE 5A-H requires a wide range of input parameters including inspection and maintenance program information and other data such as anti-tampering rates, hot/cold start mix, emission failure rates, vehicle fleet mix, fleet age distribution, etc.

The input variables used in this conformity determination were received from DEP. The inputs used for the 1990 base case existing network were the same as those used in determining the 1990 Emissions Inventory for the Commonwealth of Massachusetts. The inputs used for the years 1995 through 2025 were also received from DEP and include information on programs that were submitted to EPA in 1993, 1994, 1997, 1998, and 1999 as the control strategy for the Commonwealth to obtain ambient air quality standards for 1999.

The input variables used in the emission factor model runs for analysis of the 2000 Plan are shown in Appendix D. These inputs were determined through the consultation procedures as required by the conformity regulations. The model output provides an estimate of emissions in grams per mile for varying speeds and at varying temperatures for a variety of vehicle types. The

emission factors used in the analyses are provided in Appendix D.

Timely Implementation of Transportation Control Measures

Transportation control measures (TCMs) have been required in the SIP in revisions submitted to



EPA in 1979, 1982 and those submitted as mitigation for the construction of the Central Artery project. Those TCMs included in the 1979 and 1982 submission have all been accomplished through construction or through implementation of ongoing programs. The only exceptions are the bus immersion heater program, the Newton

Rider bus service, the private bus insurance discount concept, and the pedestrian malls in Lynn, Cambridge, and Needham. These TCMs have been substituted with other services. A list of the TCMs is provided in Appendix D. These projects have all been included in past Boston MPO Transportation Plans and TIPs.

TCMs that were submitted as a SIP commitment as part of the Central Artery mitigation are also included in Appendix D. The status of these projects has been updated using the Administrative Consent Order (ACO) signed by EOTC and the Executive Office of Environmental Affairs (EOEA) on September 1, 2000 and the quarterly summary of actions taken by EOTC, MassHighway, MBTA, and other agencies to fulfill their mitigation commitments to the Central Artery dated April 18, 2000. All of the projects have been included in the Region's Transportation Plan as recommended projects or projects requiring further study. A list of those projects include:

- Southeast Expressway High Occupancy Vehicle Lane

- HOV Lane on I-93 Mystic Avenue
- 20,000 New Park and Ride Spaces
- Ipswich Commuter Rail Extension to Newburyport
- Old Colony Commuter Rail Extension
- Framingham Commuter Rail Extension to Worcester
- Green Line Extension to Medford Hillside
- Red Line/Blue Line Connector
- South Boston Piers Transitway

The administrative consent order recently signed by EOTC and EOEA reconciles and adjusts dates of completion for all projects required as mitigation for the Central Artery that have not been completed to date. This conformity determination includes all projects that are part of the ACO. The two transit TCM SIP commitment projects that have not been completed include the Greenbush Line of the Old Colony Commuter Rail Service and the Arborway Restoration project. Substitute projects are required for these projects. These substitutes have not yet been submitted to or approved by DEP. Therefore, the Greenbush and Arborway projects have been included in this conformity determination since any substitutes will require the same air quality benefits. Thus, the emissions from these projects have been accounted for.

Consultation Procedures

The final conformity regulations require that the MPO must make a conformity determination according to consultation procedures set forth in federal and state regulations and it must also follow public involvement procedures established by the MPO under federal metropolitan transportation planning regulations.

The consultation requirements of both the state and federal regulations require that the Boston MPO, EOTC/MassHighway Planning, MA. DEP, EPA - Region 1 and FHWA - Region 1 consult on the following issues:

- Selection of regional emissions analysis models including model development and assessing project design factors for modeling.
- Selection of inputs to the most recent EPA-approved emissions factor model.
- Selection of CO hotspot modeling procedures, as necessary.
- Identification of regionally significant projects to be included in the regional emissions analysis.
- Identification of projects which have changed in design and scope.
- Identification of exempt projects.
- Identification of exempt projects that should be treated as non-exempt because of adverse air quality impacts.
- Identification of the latest planning assumptions and determination of consistency with SIP assumptions.

These issues have all been addressed through consultation among or with the agencies listed above.

Public Participation Procedures

Title 23 CFR Section 450.324 and 40 CFR 90.105(e) require that the development of the Plan, TIP, and related certification documents provide an adequate opportunity for public review and comment.

Section 450.316(b) establishes the outline for MPO public participation programs. The Boston MPO's public participation program was formally adopted in July 1994. The development and adoption of this program conforms to the requirements of the section. It guarantees public access to the Plan and all supporting documentation, provides for public notification of the availability of the Plan and the public's right to review the document and comment thereon, and provides a 35-day public review and comment period prior to the adoption of the Plan and its Conformity Determination and related certification documents by the MPO.

On November 24, 2000, a public notice was advertised in the *Boston Globe* informing the public of its right to comment on the document. On January 9, 2001 the Sub-Signatory Committee of the Boston MPO recommended that the MPO endorse the Plan and its Conformity. Consequently, on January 11, 2001 the Boston MPO voted to approve the 2000 Transportation Plan and its conformity determination. This allowed ample opportunity for public comment and MPO review of the draft document. These procedures comply with the associated federal requirements.

Financial Consistency

Title 23 CFR Section 450.324 and 40 CFR 93.108 require the 2000 Transportation Plan and Conformity Determination to “be financially constrained by year and include a financial plan that demonstrates which projects can be implemented using current revenue sources and which projects are to be implemented using proposed revenue sources.”

The 2000 Transportation Plan and Conformity Determination is financially constrained to projections of federal and state resources reasonably expected to be available during the appropriate time-frame. Projections of federal resources are based upon the estimated apportionment of the federal authorizations contained in TEA 21, as allocated to the region by the state or as allocated among the various MPOs according to federal formulae or MPO agreement. Projections of state resources are based upon historic trends. Therefore, the 2000 Transportation Plan and Conformity Determination substantially complies with federal requirements relating to financial planning.

PROCEDURES FOR DETERMINING REGIONAL TRANSPORTATION EMISSIONS

The federal conformity regulations set forth specific requirements for determining transportation emissions. A summary of these requirements and the procedures used in this Transportation Plan

and Conformity Determination as amended are summarized below.

Demographic, Employment and Transportation Demand

Specific sources of population, employment and traffic information used in the Transportation Plan have been listed above under the Latest Planning Assumptions section. Chapters 4 through 8 of the 2000 Transportation Plan present conditions and characteristics of the regional transportation system.

Chapter 9 of the 2000 Transportation Plan discusses trends and changing demands that various components of the transportation system will serve in the future years. It discusses the future roles of the highways, transit, pedestrian and bicycle travel and water travel. It also describes the scenario that was analyzed to help determine the final recommendations of the 2000 Transportation Plan.

Chapter 10 of the 2000 Transportation Plan outlines the specific project recommendations that are set forth in the Transportation Plan for the Boston MPO Region through the year 2025.

Only regionally significant projects are required to be included in the regional modeling efforts. The final federal conformity regulations define regionally significant as follows:

Regionally significant: a transportation project (other than an exempt project) that is on a facility which serves regional transportation needs (such as access to and from the area outside of the region, major activity centers in the region, major planned developments such as new retail malls, sport complexes, etc., or transportation terminals as well as most terminals themselves) and would be included in the modeling of a metropolitan area's transportation network, including at a minimum all principal arterial highways and all fixed guideway transit facilities that offer an alternative to regional highway travel. A listing of projects exempt from any air quality analysis is included in Appendix D.

TABLE 13-1
2000 Transportation Plan: Future Needs Analysis
Action Scenarios

HIGHWAY PROJECTS	2003 BUILD	2010 BUILD	2020 BUILD	2025 BUILD
Central Artery	Partial	X	X	X
Third Harbor Tunnel/ Haul Road	X	X	X	X
Haul Rd/Mass Ave/SE Expressway	X	X	X	X
Beverly-Salem Bridge	X	X	X	X
Salem Bypass Rd & Bridge St. in Salem		X	X	X
Commercial St. & Corporation Way		X	X	X
Middlesex Turnpike/Crosby Drive		X	X	X
Route 2/Crosby's Corner		X	X	X
Route 20 Widening (Farm Road to Diconza Blvd.)	X	X	X	X
Route 20 Widening (Boston Post Road)	X	X	X	X
Route 53 Widening Phase I	X	X	X	X
Route 62, Burlington	X	X	X	X
Route 38, Wilmington	X	X	X	X
Route 139 Widening	X	X	X	X
Route 140 Widening		X	X	X
Blue Hill Ave Signal Coordination	X	X	X	X
Lafayette Square Signal Coordination	X	X	X	X
Brighton Ave Signal Coordination	X	X	X	X
Marret Road Signal Coordination	X	X	X	X
Quincy Concourse Phase I	X	X	X	X
Route 3 North General Purpose Lane		X	X	X
Route 128 General Purpose Lane		X	X	X
I-495 Interchange between Rte. 9 & Rte. 20	X	X	X	X
I-93 Industriplex Interchange	X	X	X	X
Route 53 Reconstruction, Hingham/Norwell		X	X	X
Cambridgeport Roadways	X	X	X	X
Route 138 Widening, Canton	X	X	X	X
Foxborough Route 1 Improvements	X	X	X	X
Canton I-95 Dedham Street Ramps		X	X	X
Needham St/Highland Ave Reconstruction		X	X	X
Route 9 Improvements, Wellesley	X	X	X	X
COMMUTER RAIL PROJECTS				
Newburyport	X	X	X	X
Old Colony Rail, Phase I	X	X	X	X
Old Colony Rail, Greenbush Branch	X	X	X	X
Worcester - Full Service	X	X	X	X
Frequency Improvements Phase I	X	X	X	X
INTER-CITY RAIL PROJECTS				
AMTRAK Service to Portland, Maine	X	X	X	X
Northeast Corridor Electrification	X	X	X	X
RAPID TRANSIT PROJECTS				
Blue Line Modernization	X	X	X	X
Red Line/Blue Line Connection			X	X
Green Line to Medford Hillside			X	X
Mattapan Replacement Service	X	X	X	X
Restore the Green Line to Arborway	X	X	X	X
So. Boston Piers Transitway, Phase I	X	X	X	X
Washington St. Transitway (Silver Line)	X	X	X	X
Silver Line Phase B - NEMC to South Station			X	X
Airport Intermodal Transit Connector		X	X	X
HOV AND BUS PROJECTS				
Urban Ring Bus Service	X	X	X	X
HOV Lanes on the Southeast Expressway	X	X	X	X
HOV Lanes on I-93 Mystic Avenue	X	X	X	X
INTERMODAL PROJECTS				
10,000 New Park & Ride Spaces since 1991	X	X	X	X
10,000 Additional Park & Ride Spaces	X	X	X	X
North Station Improvements	X	X	X	X
South Station Transportation Center	X	X	X	X
Industriplex Intermodal Center	X	X	X	X
Rt. 128 AMTRAK/Commuter Rail Station	X	X	X	X
Commuter Boat, Inner Harbor - from North Station	X	X	X	X

In addition, specific projects have been exempt from regional modeling emissions analysis. The categories of projects include:

- Intersection channelization projects,
- Intersection signalization projects at individual intersections,
- Interchange reconfiguration projects,
- Changes in vertical and horizontal alignment,
- Truck size and weight inspection stations, and
- Bus terminals and transfer points.

The 1997 Conformity Amendments have allowed traffic signal synchronization projects to be exempt from conformity determinations prior to their funding, approval or implementation. However, once they are implemented, they must be included in determinations for future plans and TIPs.

The Action Networks are composed of projects proposed in the approved Transportation Improvement Programs, the 2000 Transportation Plan, and projects in the MBTA capital budget. A listing of the projects that meet these criteria and are included as part of the 2000 Transportation Plan Action networks is shown in Table 13-1.

In addition to emissions calculated from the network model, a separate analysis was performed off-model to determine emissions from commuter rail, commuter boat, and the MBTA bus replacement program.

Changes in Project Design Since the Last Conformity Determination Analysis

The Commonwealth requires that any changes in project design from the previous conformity determination for the region be identified. The last conformity determination was performed on the 2001-2006 Transportation Improvement Program adopted in September 2000. Since the last conformity determination a number of changes have been made. They are summarized below:

1. The Boston MPO has been in the process of changing the software that has been used in

the development of the transportation model network. This is the first conformity determination using the new software.

2. The forecast year of the Transportation Plan has changed from 2020 to 2025. This required that the Metropolitan Area Planning Council develop a new set of socio-economic forecasts (population, households, and employment) for use in the future 2025 transportation demand model network.
3. The following regionally significant projects have been eliminated from the Transportation Plan:

Highway:

- Route 126/Route 135 Grade Separation
- Route 1/114 Corridor Improvements
- Route 53 Phase II
- Route 3 South
- Route 3A Widening in Burlington
- Route 129 Widening @ Interstate 93
- Boston Street Widening in Salem
- University Avenue/Blue Hill Drive Widening
- Route 18 Widening in Weymouth
- Boundary Street/Goddard Road Connector Road
- East-West Connector Road in Canton

Commuter Rail:

- New Bedford/Fall River via Easton
- Station at Route 128 in Weston

4. The following regionally significant projects have been added to the Transportation Plan:

Highway:

- Cambridgeport Bypass Road
- Foxborough Route 1 Improvements

Rapid Transit Projects:

- Silver Line Phase B – NEMC to South Station

Model Specific Information

40 CFR Part 93.111 of the federal regulations, outlines requirements to be used in the network-based transportation demand models. These requirements include modeling methods and functional relationships to be used in accordance with acceptable professional practice and reasonable for purposes of emission estimation. The Boston MPO has used the methods described in the conformity regulations in the analysis of this 2000 Transportation Plan.

Highway Performance Monitoring System Adjustments

As stated in guidance by EPA, all areas of serious ozone and carbon monoxide nonattainment must use the Federal Highway Administration's Highway Performance Monitoring System (HPMS) to track vehicle miles of travel (VMT) prior to attainment to ensure that the state is on line with commitments made in reaching attainment of the ambient air quality standards by the required attainment dates. The Massachusetts Highway Department (MassHighway) provides the HPMS information to DEP. DEP used this information in setting mobile source budgets for VOC, NO_x, and CO in all SIP revisions prior to 1997. DEP has since revised its VOC and NO_x budgets using transportation demand model runs factored to HPMS data. HPMS remains the accepted tracking procedure set forth by EPA. The CO budget for the Boston area CO attainment area had been set prior to using transportation model data.

The conformity regulations require that all model-based VMT be compared with the HPMS VMT to ensure that the region is in line with VMT and emission projections made by DEP. An adjustment factor has been developed which compares the 1995 HPMS VMT to the 1995 transportation model VMT. This adjustment factor is then applied to all modeled VOC and NO_x emissions for years 2003 through 2025 to ensure consistency with EPA accepted procedures.

$$\frac{1995 \text{ HPMS VMT}}{1995 \text{ Modeled VMT}} = \text{Adjustment Factor}$$

$$\frac{55,244,000}{74,560,260} = 0.7409 \text{ Adjustment Factor for VOC and NO}_x$$

1997 was chosen as the base year for modeled emission estimates for the entire Eastern Massachusetts Non-Attainment Area (previous conformity determinations had used 1990 - now outdated - as a base year). Some regions, including the Boston MPO, selected a different model base year due to better data availability (consistent with the latest planning assumptions). HPMS-factored model results from these regions have been adjusted to represent 1997 estimates so that all regions could be added together to produce a benchmark level for the entire Non-Attainment area. These results are shown in Tables 13-2 and 13-3.

Since the CO emission budget for the Boston CO attainment area was determined using the HPMS method rather than the transportation model, a different adjustment factor is applied to the CO emissions for the nine cities and towns. This was done by comparing the 1990 CO emissions from the nine cities and towns resulting from the 1990 base year model run to the 1990 HPMS generated CO emissions submitted as part of the SIP. The HPMS data was divided by the model data to determine the CO adjustment factor to be applied to all modeled CO emissions for future years. This calculation is as follows:

$$\frac{1990 \text{ HPMS Emissions}}{1990 \text{ Modeled Emissions}} = \text{Adjustment Factor}$$

$$\frac{343.41 \text{ tons/day}}{483.17 \text{ tons/day}} = 0.71 \text{ CO Adjustment Factor}$$

THE CONFORMITY TEST

Consistent with emission budgets set forth in SIP

The Boston MPO has conducted an air quality analysis of the 2000 Transportation Plan. The purpose of the analysis is to evaluate the Plan's air quality impacts on the State Implementation Plan (SIP). The analysis evaluates the change in ozone precursor (VOCs and NO_x) emissions and carbon monoxide emissions due to implementation of the

TABLE 13-2
VOC Emissions Estimates for the Eastern Massachusetts Ozone
Nonattainment Area
 (all emissions in tons per summer day)

Year	Boston MPO* Action Emissions	Eastern MA Action Emissions	Budget	Difference (Action -Budget)
1997	119.176	219.059	n/a	n/a
2003	57.513	114.974	117.118	-2.144
2010	51.184	104.510	117.118	-12.608
2020	53.399	110.221	117.118	-6.897
2025	52.617	112.309	117.118	-4.809

TABLE 13-3
NOx Emissions Estimates for the Eastern Massachusetts Ozone
Nonattainment Area
 (all emissions in tons per summer day)

Year	Boston MPO* Action Emissions	Eastern MA Action Emissions	Budget	Difference (Action -Budget)
1997	179.858	341.458	n/a	n/a
2003	112.214	235.285	243.328	-8.043
2010	106.518	224.007	243.328	-19.321
2020	111.069	234.361	243.328	-8.967
2025	109.835	236.618	243.328	-6.710

TABLE 13-4
Winter Carbon Monoxide Emissions from the CO Maintenance
Area for the Nine Cities in the Boston Area
 (Tons/Winter Day)

Year	Action Emissions	SIP Emissions Projections	Difference (Action -Budget)
1993	305.43	n/a	n/a
2003	169.39	226.00	-56.61
2005	168.43	217.53	-49.10
2010	166.01	228.33	-62.32
2020	161.19	228.33	-67.14
2025	158.78	228.33	-69.55

**Note: Does not include commuter rail, commuter boat and MBTA bus emissions which are listed in Appendix D.*

2000 Transportation Plan. The modeling procedures and assumptions used in this air quality analysis follow the EPA's final conformity regulations issued on August 15, 1997. They are also consistent with procedures used by the Massachusetts Department of Environmental Protection to develop Massachusetts' 1990 Base Year Emission Inventory, 1996 Reasonable Further Progress Plan, the Post-1996 Reasonable Further Progress Plan, 1996 Rate of Progress Report, and the Ozone Attainment Demonstration for the SIP. All consultation procedures were followed to ensure that a complete analysis of the 2000 Transportation Plan and Conformity

Determination as amended was performed with consistency with the SIP.

The primary test to show conformity with the SIP is to show that the Air Quality Conformity of the 2000 Transportation Plan is consistent with the emission budgets set forth in the SIP. The Massachusetts Reasonable Further Progress Plan (RFP) has been deemed complete by the EPA in a letter dated June 5, 1997. EPA has made a determination that the 15% RFP SIP submittal contains an adequate mobile source emissions budget

to conduct conformity determinations using the conformity criteria. In addition, the 2003 mobile source emission budget was found adequate for conformity purposes by EPA on February 19, 1999.

The VOC mobile source budget for 2003 for the Massachusetts Eastern Nonattainment Area has been set at 117.118 tons per summer day and the 2003 mobile source budget for NOx budget is 243.328 tons per summer day.

The CO mobile source attainment inventory for 1993 for the nine cities in the Boston area recently reclassified as attainment is 305.43 tons per winter day. The projections provided for mobile sources for the Boston area are 266.13 tons per winter day for 1995, 226.0 tons per winter day for 2000, 217.53 tons per winter day for 2005, and 228.33 tons per winter day for 2010.

The total tons per day of VOCs and NOx for the Eastern Massachusetts nonattainment area from all of the analyzed scenarios are shown in Tables 13-2 and 13-3. The total tons per winter day of CO emissions for the nine cities in the Boston maintenance area are shown in Table 13-4. The results of the air quality analysis demonstrate that the VOC, NOx, and CO emissions from all

TABLE 13-5*
Winter Carbon Monoxide Emissions from the CO Nonattainment Area only for the City of Waltham (Kilograms/Winter Day)

Year	Baseline Emissions (1990)	Action Emissions	Difference (Action -1990 Emissions)
1990	31,457	n/a	n/a
2003	n/a	16,492	-14,965
2005	n/a	16,464	-14,993
2010	n/a	16,394	-15,063
2020	n/a	16,254	-15,203
2025	n/a	16,184	-15,273

Action scenarios are less than the Massachusetts VOC, NOx, and CO emission budgets.

CONTRIBUTE TO REDUCTIONS IN CO NONATTAINMENT AREAS

The City of Waltham must report CO emissions within their city because they are classified as nonattainment for CO. The baseline vs. action test or the less than 1990 emissions test must be done in Waltham because there has been no mobile source emission budget established for this area. Table 13-5 reports the action CO emissions as compared to the 1990 CO emissions from Waltham. As shown in Table 13-5, the emissions from all the action scenarios are less than the 1990 baseline emissions. Therefore, the less than 1990 emissions test is met.

CONCLUSION

The Clean Air Act Amendments of 1990 established new requirements for transportation plans, programs, and projects. EPA published a final rule in the November 24, 1993, Federal Register which was last amended on August 15, 1997, providing procedures to be followed by the United States Department of Transportation in determining conformity of transportation plans, programs, and projects with the SIP.

The Boston MPO has conducted an air quality analysis of the 2000 Transportation Plan and its latest conformity determination. The purpose of the analysis is to evaluate the plan's air quality impacts on the SIP. The analysis evaluates the change in ozone precursor emissions (VOCs, and NOx) and CO emissions due to the implementation of the 2000 Transportation Plan. The modeling procedures and assumptions used in this air quality analysis follow EPA's and the Commonwealth's guidance and are consistent with the procedures used by the Massachusetts DEP to develop Massachusetts' 1990 Base Year Emissions Inventory, 1996 Reasonable Further Progress Plan, the Post-1996 Reasonable Further Progress

Plan, 1996 Rate of Progress Report, the Ozone Attainment Demonstration for the SIP and the emissions inventory for the Boston area CO maintenance area included in the SIP.

Eastern Massachusetts has historically been designated as a Serious ozone nonattainment area. The City of Waltham is designated as nonattainment for CO. Nine cities and towns in the Boston area have recently been redesignated from nonattainment to attainment for CO. The EPA conformity regulations require that transportation plans, programs, and projects evaluate their impact on nonattainment areas. Eastern Massachusetts is made up of ten regional planning agencies (RPAs), therefore VOC and NOx emissions must be combined in order to compare the results to the conformity criteria.

EPA has found the base year emissions inventories, the 15% Plan, the 9% Plan, and the contingency submittal administratively and technically complete in a letter dated June 5, 1997. In addition, the 2003 mobile source emission budget was found adequate for conformity purposes by EPA on February 19, 1999. This establishes the new mobile source emission budgets for which the new conformity determinations will be based. In addition, EPA has made a conditional interim approval of the Massachusetts 15% Rate of Progress Report and Contingency Plan in a letter dated June 18, 1997.

Accordingly, the EOTC has found the emission levels from the Boston MPO 2000 Transportation Plan and Conformity Determination in combination with the emission levels from the other RPAs in Eastern Massachusetts to be in conformance with the SIP according to conformity criteria. Specifically, the following conditions are met:

- The VOC emissions for the Action (build) scenarios are less than the 2003 VOC mobile source emission budgets for analysis years 2003 through 2025.
- The NOx emissions for the Action (build) scenario are less than the 2003 NOx mobile source emission budgets for analysis years 2003 through 2025.
- The CO emissions for the Action (build) scenarios are less than the 1993 CO mobile source emission budget and projections for analysis years 2005 through 2020 for the nine cities in the Boston area CO maintenance area.
- CO emissions for Waltham for the Action (Build) scenario for all analysis years are less than Waltham's base year 1990 emissions.

In accordance with Section 176(c)(4) of the Clean Air Act as amended in 1990, the MPO for the Boston Region has completed its review and hereby certifies that the Boston MPO 2000 Transportation Plan and its latest conformity determination conditionally conforms with 40 CFR Parts 93 and 310 CMR 60.03.



CHAPTER 14

NEXT STEPS

The past decade has seen an unprecedented level of spending on the Central Artery/Ted Williams Tunnel project and its associated environmental and regulatory commitments, the statewide road and bridge program and MBTA capital expansion projects. This Regional Transportation Plan (RTP) presents a vision of the future that allocates a major portion of future transportation spending on the preservation of the existing system.

While the 2000-2025 Transportation Plan is comprehensive in nature and contains a full financial plan and air quality analysis, the Boston MPO is committed to continue work on its long-range transportation planning efforts. Specifically, the MPO is committed to re-evaluating all of the assumptions contained within this plan and producing an updated 2001-2025 Transportation Plan by Summer 2001. The work that will be done will follow a number of major themes. These themes include:

- Financial capacity
- Environmental Justice measures
- Land use alternatives
- Projects for additional study and incorporation of other planning studies
- Reassessment of projects included in the plan
- Refinement of policies
- Expanded public outreach
- Incorporation of additional data for the travel demand model

Financial capacity: Actions on the part of the Commonwealth over the past two years have produced a major shift in how transportation projects will be funded in the future.

In 1999, the Legislature and Governor approved

the "Forward Funding of the MBTA" that dramatically changes the financial structure of the MBTA. The legislation gave the MBTA its own bonding authority, expanded its boundaries and established a source of dedicated revenue. In years past the Commonwealth placed its full faith and credit behind bonds used for MBTA

capital projects, now the authority will issue its own bonds for capital projects. The MBTA district was expanded from 78 to 175 communities, including most communities in Eastern Massachusetts. This now means that the T district extends far beyond the boundaries of the Boston MPO. One penny of every five cents of sales tax collected on a dollar purchase is now dedicated to the MBTA fund.

At least one project included in this 2000-2025 Transportation Plan will depend on Federal New Start money. The Silverline Phase B (tunnel from New England Medical Center to South Station) is included in the plan to allow for the MBTA to begin the process of applying for planning and design money. If this project is not deemed eligible for New Start money, then it is doubtful that it will be constructed by the MBTA.

On the highway side, MassHighway has guaranteed signed a Memorandum of Understanding (MOU) with the regional planning agencies providing a minimum amount of future funding for the Statewide Road and Bridge Program. This MOU was facilitated by the Federal Highway Administration to ensure an adequate amount of

funding for the existing roadway infrastructure across the state in light of cost overruns on the Central Artery project.

Work over the next six months will include looking at the MBTA financial assumptions and deter-

mining if it is reasonable to make modifications to some of these assumptions to allow for additional capital investment proposals to be included in the 2001-2025 Transportation Plan.

This RTP makes an assumption as to the level of infrastructure investment needed to maintain the existing

system. The MPO will work with MassHighway and the MBTA to better define a reasonable level of future funding to maintain the roadway and transit networks.

Environmental Justice: The measures included in this 2000-2025 Transportation Plan represent a first step toward ensuring Environmental Justice compliance for the Boston region. The MPO has used federal transportation measures included in the Title VI report as a starting point for transit measures. On the highway side, the examined bridge sufficiency ratings and TIP investments.

Over the next six months, the Boston MPO is committed to working with community representatives in further refining Environmental Justice measures to apply to future planning and funding decisions.

These measures would be used as criteria in developing planning work programs for the Unified Planning Work Program, specific short-term projects for inclusion in the Transportation Improvement Program (TIP) and future projects in the long-range Transportation Plan.



New Green Line Type 8 Vehicle

Land Use Assumptions: This plan uses a land use assumption based on the Extended Trends scenario developed by the Metropolitan Area Planning Council (MAPC). This scenario assumes that future land use, population, household and employment growth patterns will mirror those of the past two decades. In addition to the Extended Trends scenario, the MAPC has also developed two other possible land use assumptions, Scenario B "Water and Sewer Constraint" and Scenario C, Targeted Growth.

Over the next six months, the Boston MPO will analyze these alternative land use scenarios using the CTPS travel demand model to forecast the projected changes in travel demand across the region. There is the possibility that a fourth alternative may be explored after analyzing the impacts of the three current land use scenarios.

Projects for additional study and incorporation of other planning studies: This 2000-2025 Transportation Plan is constrained in the number of projects included. The MPO decided that it needed to have a better sense of its future financial funding alternatives before it could responsibly include additional projects in the plan.

Over the next six months, the MPO will solicit further public input into which projects should be examined for inclusion in the 2001-2025 Transportation Plan. The results from the Access Boston study, the City of Boston's long range transportation plan, should be available within that timeframe and its recommendations will be able to be more fully incorporated into the 2001-2025 Transportation Plan. Beginning in 2001, the MPO will be supporting work by the MBTA on the Program for Mass Transportation (PMT), a state required long-term transit planning effort. Other major

planning efforts will be underway which may influence the decision making process for the 2001-2025 Transportation Plan. Efforts include the North Shore MIS, the Urban Ring MIS, the Lower North Shore Transportation Study, the South Weymouth Naval Base Reuse and the Amtrak study of the North Station-South Station Rail Link.

Reassessment of projects included in the 2000-2025 Transportation Plan: In developing the 2001-2025 RTP, the MPO believes that it is fiscally and environmentally prudent to take a look at each of the projects included in this plan and judge them against other potential transportation projects.

Over the next six months, the MPO will assess the value of each of the projects included in the 2000-2025 Transportation Plan against those projects identified for additional study.

Refinement of Policies: The MPO decided to use the policies of TEA-21 as a foundation for its regional transportation policies. The nine policies presented in Chapter 1 are a first effort at establishing priorities for the region.

Over the next six months, the MPO will further refine its nine policies so that they are clear and concise enough to allow for the MPO and the general public to understand the priorities of the region. These policies will serve to

help policy-makers in determining where it is most appropriate to allocate financial resources in the future. Indeed one of the main goals of the 2001-2025 Plan is to more clearly connect project selection to MPO policies.

Expansion of public outreach: The public outreach for the 2000-2025 Transportation Plan has



included making presentations at more than 80 public meetings, it has included a web site devoted to the Transportation Plan and reached out to local elected officials. But there is a need to do even more.

Over the next six months, the Boston MPO will work to expand the public outreach involved in not just the 2001-2025 Transportation Plan but also other planning efforts under the purview of the Boston MPO. The MPO sees this plan as a good starting point for further discussions between the MPO representatives and the various transportation stakeholders. This expansion will include trying to reach out to the non-transportation community to better understand the need of

commuters, transit- dependent persons, students, the elderly and persons disabilities.

Incorporation of additional data from the travel demand model: This RTP represents the first use of the MPO's new travel demand model. In addition, updated socioeconomic forecasts for population, households and employment were developed by MAPC.

Over the next six months, the Boston MPO will work to refine the model inputs and produce alternative views of the future using the MAPC land use alternatives and MPO agree-upon transportation alternative networks.



A

PROJECTS INCLUDED IN THE TRANSPORTATION PLAN

PROJECTS INCLUDED IN THE 1995 BASE CASE SCENARIO

These are projects that were completed on or before December 31, 1995, and are included in the 1995 Base Case Scenario for the travel demand model runs.

Urban Ring bus service: This MBTA circumferential bus service was begun in 1994. It consists of three limited stop bus routes providing connections among the Red Line, the Orange Line and the Green Line branches. The three services are:

- CT1: Central Square (Cambridge) to B.U. Medical Center (Boston)
- CT2: Kendall Square (Cambridge) to Ruggles Station (Boston) via Longwood Medical area. The service extension to Sullivan Square begun in 2000 is included in the 2025 No-build scenario.
- CT3: Andrew Station (South Boston) to Longwood Medical area (Boston) via Ruggles Station. The service extension of the CT3 to Logan Airport instituted by the MBTA in September 1999 is included in the 2025 No-build scenario..

Worcester commuter rail, partial service: This MBTA commuter rail service from Framingham station to Worcester station with no intermediate stops began in September, 1994. This includes four inbound trains from Worcester in the morning and 1 in the afternoon and four outbound trains from Framingham in the afternoon and 1 in the evening. This service does not include any of the proposed station stops to be built as part of the full service. The Grafton Station was opened in February, 2000.

New parking spaces (3,251): These are the new parking spaces added between January 1, 1991 and December 31, 1995. Parking spaces were added at eleven commuter rail stations, including Needham Heights, Worcester, Lowell, Lynn, Readville and West Concord.

South Station Transportation Center: This MBTA improvement is the intercity bus terminal above the commuter rail tracks and platforms at South Station. The facility was opened in October 1995. The facility serves intercity bus carriers, major regional carriers and commuter bus operators. The bus concourse has 23 saw-tooth docks, four pull-through docks and two airport link docks. This does not include a pedestrian connector between the bus station and the railway station.

Route 53, Phase 1 Hanover: Widening of Route 53 from Route 3 to Mill Street (Hanover) was completed by MHD in 1994. This project widened Route 53 from a two lane to a five lane roadway segment.

HOV lanes on I-93 Mystic Avenue: This MHD project is an extension of the existing southbound HOV lane to the Sullivan Square (Somerville) off-ramp. The HOV lane is for vehicles with two or more occupants and is a total of 2.03 miles in length. The extension was opened in September 1994.

HOV lanes on the Southeast Expressway: This six-mile HOV lane is between Furnace Brook Parkway (Quincy) and Freeport Street (Dorchester-Boston). The facility opened in November 1995. It uses contra-flow technology, in which a travel lane is reallocated from the off-peak side of the expressway to the peak side for the duration of the peak period. Originally the HOV lane was for vehicles with 3 or more persons. This does not include the revision to the occupancy rate which was reduced to 2 or more persons via a sticker program and then later instituted as 2 or more by right in 1999.

Ted Williams Tunnel: The Ted Williams Tunnel (aka/ Third Harbor Tunnel) extends 1.6 miles (.75 miles under water) from South Boston (Boston) to Logan Airport property (East Boston). It opened for commercial traffic only on December 15, 1995. The approximate cost for the tunnel was

\$1.5 billion. The 1995 base case does not include the provision for general purpose use of the tunnel on week-ends instituted in Fall 1996.

South Boston Bypass Road (aka/Haul Road): The roadway segment runs from the Ted Williams Tunnel (South Boston) to near the I-93/Massachusetts Avenue inter-

change (Boston). The roadway is restricted to commercial vehicles only. It was opened in July 1993. This roadway project is part of the Central Artery project. This does not include the completed interchange between the Bypass road and I-93.

PROJECTS INCLUDED IN THE 2025 NO-BUILD SCENARIO

These are projects that will come on line after January 1, 1996. They are either already completed, under construction or already advertised for construction.

Commuter boat in the Inner Harbor: Additional MBTA commuter boat service includes new service from Lovejoy Wharf (North Station-Boston) to Courthouse Fan Pier (South Boston) and World Trade Center (South Boston). This is in addition to existing service at Charlestown Navy Yard, Long Wharf (Boston), and Logan Airport (Boston). Lovejoy Wharf and Courthouse Fan Pier were both opened in 1999.

Newburyport commuter rail service: Extension of a MBTA commuter rail line from Ipswich sta-



tion (Ipswich) to Newburyport, a total length of 9.6 miles. There is an intermediate stop with a new station and associated parking at Rowley. The service opened in October 1998. The additional parking at Rowley and Newburyport stations is included in the 15,931 New Parking Spaces. The service includes 13 inbound and 13 outbound trips during the week and 6 inbound and 6 outbound trips on the weekend.

Commuter Rail Frequency Improvements:

Improvements have been made to the Rockport/Ipswich, Framingham/Worcester, Franklin, and Haverhill commuter rail lines.

Old Colony commuter rail service: This MBTA commuter rail service includes the restoration of two of the Old Colony lines. Service runs from South Station to Middleborough/Lakeville with six intermediate stops and service from South Station to Kingston and Cordage/Plymouth with six intermediate stops. Service on the two lines began in September 1997. The additional parking at the stations is included in the 15,931 New Parking Spaces. This project does not include the proposed Greenbush branch of the Old Colony commuter rail line.

15,931 new parking spaces: This total was built between January 1, 1996 and the end of 1999. The additional spaces include the restoration of two branches of the Old Colony commuter rail and the extension of commuter rail to Newburyport.

Beverly Salem Bridge: Replace a drawbridge over the Danvers River/ Beverly Harbor connecting the cities of Beverly and Salem with an elevated fixed structure. The 2025 No-Build Scenario does not include the final two phases of the Beverly/Salem Bridge project—the construction of the Bridge Street Bypass Road and the widening of Bridge Street from Flint Street to beyond the Washington Street Rotary. The bridge opened for traffic on August 2, 1996.

Blue Hill Avenue signal coordination: This MassHighway project involved the coordination of signals along the Blue Hill Avenue corridor in Boston.

Brighton Avenue signal coordination: This MassHighway project involved the coordination of signals along the Brighton Avenue corridor in Boston.

Route 139 (Marshfield): This MassHighway project consisted of the reconstruction, widening and installation of traffic signals on Route 139 in Marshfield from the Route 3 off-ramp to the Pembroke town line.

Route 20 Segment 1 (Marlborough): Widen a 1.1-mile section of Route 20 from 2 lanes to 4 lanes. The project extends from just west of Farm Road to the Raytheon traffic lights just east of DiCenzo Boulevard. The project includes the replacement of traffic signals at the intersection of Route 20 and Farm Road & Wilson Street, the installation of traffic signals at DiCenzo Boulevard (West), and the coordination of these two signals and existing signals at Hager Street and Raytheon Company Drive. This project opened to traffic in October 1999.

Route 128 Amtrak/commuter rail station: This project jointly constructed by Amtrak and the MBTA will consist of a new station for the Northeast Corridor Amtrak service and the MBTA Attleboro service. At full-build, the station will have an associated parking garage with 2,750 parking spaces (550 reserved for Amtrak). Electrified trains (Amtrak) began serving the station in 2000. Full build is not expected until 2005 with the completion of an access road to Route 128.

Central Artery: The Central Artery/Tunnel project is the largest, most complex and technologically challenging highway project in American history. The estimated cost of the project is \$14 billion with a final completion date estimated at December 2004. This Massachusetts Turnpike Authority project is highlighted by the construction of an 8-to-10 lane, limited access, 1.5 mile underground expressway to replace the existing elevated I-93 highway. Other components of the project are the Ted Williams Tunnel from South Boston to Logan Airport, an extension of I-90 from near South Station to Logan Airport and

Route 1A in East Boston, four major highway interchanges, a cable-stayed bridge across the Charles River, and the reconstruction of an additional 2.1 mile segment of I-93. In all the project is building or rebuilding 161 lane miles of urban highway, about half in tunnels, in a 7.5 mile corridor. Approximate completion dates are:

- Ted Williams Tunnel (opened December 15, 1995-included in 1995 Base Case)
- South Boston Bypass Road (opened 1993-included in 1995 Base Case)
- Charlestown/Lev-
erett Circle Bridge (opened October 7, 1999)
- I-90 Extension to the Ted Williams Tunnel (approximately April 2002)
- I-93 Northbound (approximately November 2002)
- I-93 Southbound (approximately November 2003)
- Project completion (approximately December 2004)

North Station improvements: This MBTA project includes the relocation of the above ground portion of the Green Line to Lechmere to underground. The new rapid transit station will include a super platform with easy transfers between the Green and Orange lines.

Blue Line platform lengthening and modernization: The modernization program to allow for six car operation is underway. Modernization of stations from Wood Island to Wonderland is complete. Aquarium station will be renovated in conjunction with the Central Artery work.



Additional parking spaces: Included in the recommended plan is the addition of at least 1,050 new surface parking spaces. At an average cost of \$5,000 per space, this is a total cost of approximately \$5.2 million. Additional proposed spaces are located at the following commuter rail sites within the Boston MPO region: Hamilton, West Gloucester, North Wilmington, Walpole and

Sharon. An additional 1,685 spaces outside of the Boston MPO region were included in the travel demand model analysis. Locations included Mansfield, Middleborough, Halifax and Lowell. These figures do not include parking associated with the Worcester or Greenbush Commuter Rail extensions.

Worcester commuter rail, full service: This MBTA service will include intermediate stops in Grafton, Westborough, Southborough and Ashland. Each stop will include a new commuter rail station with associated parking. This service will replace the interim service provided between Framingham and Worcester. Full service is anticipated in the year 2001.

Silver Line-Transitway, Section A: This MBTA transitway will provide service via tunnel from South Station (Boston) to the World Trade Center (in the vicinity of Viaduct Street) with an intermediate station stop at Courthouse Station (in the vicinity of Northern Avenue and Farnsworth). Construction on this project is underway and Phase 1 service is scheduled to begin in 2002. This does not include Phase 2—full build. Phase 2 connects South Station to Boylston Street Station (Boston). It also includes a surface route from the D Street portal to City Point (South Boston).

Mattapan refurbishment: This MBTA project is the refurbishment of the existing PPC (Presidential Conference Committee) cars currently run-

ning on the Mattapan High-Speed line (Boston-Mattapan-Milton). There are no scheduled run time or frequency improvements associated with this project.

I-495 interchange (Marlborough/Southborough): Construct an interchange to Interstate 495 between Route 9 and Route 20. Major elements of the work include the construction of four entrance/exit ramps for I-495 with two bridges and a connector road from the ramps to Crane Meadow Road, as well as the reconstruction and signalization of Crane Meadow Road. This project was advertised in September 1998 and work is ongoing.

I-93/Industriplex interchange (Woburn): Construct an interchange to Interstate 93 between Interstate 95 and Route 129. Major elements of the work include the construction of four entrance/exit ramps for I-93 with two bridges and a connector road from the ramps to Commerce Way, as well as the reconstruction and signalization of the Commerce Way intersection. This project was advertised in June 1997 and was opened to traffic in October 2000.

Quincy Center Concourse, Phase 1: Construct the Quincy Center Concourse Bridge connecting Burgin Parkway to Parkin Way. The work also includes the reconstruction of sections of Burgin Parkway, the Granite Street Connector, and Parkin Way, including the installation of an interconnected traffic signal system. The 2025 No-Build Scenario does not include the final two phases of the Quincy Center Concourse project—the connection of Burgin Parkway to Hancock Street (the Westside Link) and the connection of Hancock Street to Mechanic Street/ Revere Road (the Eastside Link). This project was advertised in October 1998.

Route 62 and Middlesex Turnpike (Bedford & Burlington): Make traffic safety improvements to Route 62 between the Route 3 overpass and Network Drive (formerly Kent Road) and to Middlesex Turnpike from Lexington Street to Terrace Hall Avenue and Network Drive. The improvements to Route 62 include the installation of a

traffic signal and the reconstruction of two others, the widening of the roadway from two to four lanes, and the installation of a sidewalk along one side of the roadway. Work on Middlesex Turnpike includes the installation of two traffic signals and the reconstruction of two others, the widening of the roadway from two to four lanes and an additional left turn lane at three separate locations, and the installation of a sidewalk along one side of the roadway.

Route 9 (Wellesley): Widen Route 9 from 4 lanes to 6 lanes from Willow Street to the Interstate 95 (Route 128) northbound on-ramp. This project was advertised in July 1999.

Amtrak Northeast Corridor Electrification: This Federal Railroad Administration/Amtrak project involves the electrification of the Northeast Corridor rail line from Boston to New Haven, CT, the purchase of high-speed train sets and expansion of Boston to New York passenger train service. Service using the electrified track began in 2000. Acela high-speed service will begin in December, 2000.

Marrett Road (Lexington) signal coordination: This MassHighway project consists of reconstructing Route 2A (Marrett Road) from I-95 (Route 128) west to beyond the Massachusetts Avenue extension.

Route 138 (Canton): Widen Route 138 from 2 lanes to 4 lanes from the Route 128 Interchange (the northern limit of the Washington Street Bridge) to 200 meters north of the intersection of Route 138 and Royall Street/Blue Hill River Road. This project was advertised in August 1999 and is expected to be completed and open to traffic in October 2000.

Industriplex Intermodal Center (Woburn): This is a joint agency (MHD, Massport, MBTA) project. The Industriplex in Woburn provides an intermodal facility for the northern suburbs that combines MBTA commuter rail, Massport's Logan Express shuttles, a 2,400 space parking lot, and a station on Amtrak's future service to Portland, Maine. Ground was broken on the Industriplex in 2000. MassHighway has completed a

new interchange with Interstate 93 that improves access to the facility. In addition to its intermodal component, Industripex provides improved access to both I-93 and Route 128, is adjacent to growing employment centers and increases parking capacity. The parking increase partially addresses SIP commitment of new park and ride spaces.

Route 38 (Wilmington): This MassHighway project consists of widening and reconstructing Route 38 from Route 129 (Richmond Street) to Middlesex Avenue. Signalization improvements will be made at the intersections of Route 38/Clark Street, Route 38/Wilmington Plaza and Route 38/Richmond Street.

PROJECTS ADDED AS THE 2025 BUILD SCENARIO

Silver Line-Washington Street, Section C: (\$54,000,000) The MBTA's Silver Line is to initially run along Washington Street from Dudley Square in Roxbury to Downtown Crossing in the city of Boston. The vehicles used on the route are 60-foot articulated compressed natural gas buses and their low-floor design makes them handicapped accessible. The buses operate in mixed traffic from Dudley Square to Melnea Cass Boulevard where they then enter a reserved lane. At the Massachusetts Turnpike, the reserved lane ends and the vehicles enter mixed traffic again. Proposed stations for the Silver Line include Dudley Square, Melnea Cass Boulevard, Lenox Street, Newton Street, Cathedral, East Berkeley Street. Additionally, the vehicle will make stops at Herald Square, New England Medical Center, Chinatown, and Downtown Crossing. This project is a Central Artery/Tunnel commitment. It is scheduled to be completed before 2002.

Route 128 Additional Lanes: (\$97 million) This project involves the addition of one travel lane in each direction to increase capacity on a segment of Route 128/I-95. The project limits are from Route 24 (Randolph) to Route 9 (Wellesley), a total of 13.7 miles. Other towns within the project limits are Canton, Westwood, Dedham, and Needham. The project also includes modifications to

bridges and the redesign of the Highland Avenue Interchange (Needham). This project will have a phased design and construction process. The early design phases are active. This project was included in the 1997 Transportation Plan.

AITC (Airport Intermodal Transit Connector): (\$35 million) This project would provide a new transit service in Boston from South Station Intermodal Center to the Logan Airport terminals. There would be approximately eight vehicles which would be similar to those used in the Silver Line-Transitway Section A, except that these vehicles have more luggage storage space. The service would use the MBTA South Boston Piers Transitway tunnel from South Station to South Boston and then the Ted Williams Tunnel to the five Logan Airport terminals. The capital portion of this service would be sponsored by Massport. This service would provide for enhanced connection between the Red Line and Logan Airport. There would continue to be AITC bus service between the Blue Line Airport Station and the Logan airport terminals. This project must be completed by June 2004 as part of the administrative consent order between EOTC and EOEA.

Massachusetts Avenue Lafayette Square: (\$4.4 million) This project would realign the intersection of Main Street/Mass. Ave./Columbia Street in Cambridge. The signalized intersection would be moved to a realigned 4-way intersection opposite Sidney Street on the south. Right-of-way takings necessary have been completed (gas station at corner of Main/Mass. Ave). This project will complement other MassHighway work done as part of the Cambridgeport Roadways project. This project is included in the model because of the coordination of signals along Massachusetts Avenue, not because of its regional significance.

Route 1 and Associated Improvements: (\$14 million) As a result of a directive from the Massachusetts Legislature, MassHighway will oversee a project to improve access to the new CMGI Field being built adjacent to Foxboro Stadium. Contract #1 focuses on the area from the intersection between Route 1 and North Street to the intersection of Route 1 and Pine Street in the town of

Foxborough. A grade-separated interchange is to be built at the north end of the stadium on Route 1. A flyover bridge/ramp will be built on the south side of the stadium to Route 1. A new access drive will be built from North Street into the stadium. The cost of this contract is \$10 million. Contract #2 deals with improvements along Route 1 between the two nearest interstate highways. A new slip ramp is to be constructed at the Route 1 / Interstate 95 interchange in Sharon. New sidewalks will be built on North Street from the access road to the Walpole town line. The shoulder along Route 1 in Foxborough and the Route 1 / Interstate 495 ramps in Plainville will be widened. Regional and local signage improvements are also part of this contract. The cost for Contract #2 is \$4 million.

Telecom City Roadways: (\$24 million) Reconstruction of Commercial Street at Medford Street in Malden to include new traffic signal equipment serving four 11 foot lanes plus 4-foot outside shoulders. In the southbound direction, the alignment of the existing reverse S-curve will be flattened to improve safety. Commercial Street will include a northbound and a southbound lane separated by a median, which will be narrowed in select locations to accommodate a protected southbound left turn lane. Commercial Street becomes Corporation Way upon entering Medford. At the southern end of the project, a new road connects Corporation Way in Medford with Santilli Highway in Everett. This road crosses the Malden River. This improvement will serve future development of the TeleCom City project by the Mystic Valley Development Commission. The development focuses on the creation of a new center for applied high tech applied research and product development. In 1997, the average daily traffic volumes for Commercial Street at the Malden-Medford city line was 9,600 vehicles. A MEPA certificate was issued on August 7, 2000. No Environmental Impact Report is required. The project is at 75% design.

Industriplex Intermodal Center Phase 2: (\$1 million remaining cost) This phase of the project includes the completion of the Massport Logan Express service and parking lot.

Route 20, Segment 2 & 3: (\$7.2 million) This project involves the reconstruction of Route 20 in Marlborough. The West Main Street portion involves no new added capacity, just reconstruction along a .7 mile stretch of Route 20 between Beach Street and Grainger Boulevard. There is no new right of way involved, only some corner rounding. This portion of the project is at 75% design. The estimated construction cost is \$2 million. The east Marlborough portion extends from the Farm Road intersection almost to the Sudbury Line. For one mile Route 20 is widened from one lane in each direction to two lanes. Construction of this segment is 95% complete. The cost for this segment is \$1.8 million. The west Marlborough segment is from the Northborough town line to Felton Street, a distance of 1.3 miles. The .9 mile portion of Route 20 from Felton Street to Ames Street will be widened from one lane in each direction to two lanes. There is no new capacity on the remaining portion of the project. This segment also includes installation of a new signal at the intersection of Route 20 and Williams Street, almost one mile east of Felton Street. The estimated cost of construction for the west segment is \$3.4 million.

Route 140: (\$18 million) Route 140 in Franklin is to be widened from one lane in each direction to two lanes in each direction from I-495 to Garelick Farms. The alignment of Route 140 will also be altered to accommodate an improved diamond interchange. The length of Route 140 affected by the project is 1.2 miles. The average daily traffic volumes on this portion of Route 140 were 13,500 vehicles in 1996.

Route 3 North: (\$385 million) The project widens Route 3 along a 21-mile stretch from Burlington to the New Hampshire border. The affected towns are Bedford, Billerica, Chelmsford, Westford, Tyngsborough, as well as Burlington. The highway is currently 2 lanes in each direction and will be expanded to 3 lanes. There will also be full right and left shoulders in each direction. All of the bridges along the corridor will be reconstructed to accommodate a potential fourth lane in each direction. The average daily traffic volumes for the New Hampshire border

end of the project were 63,800 vehicles in 1999. On the Billerica portion of the project, the average daily traffic volumes were 84,000 vehicles. The MEPA approval process is complete. The design-build agreement was approved by MassHighway on August 2, 2000. There is an approximate 42-month design/build schedule. The cost and programming for this project is being carried in the Northern Middlesex Council of Governments Transportation Plan.

Cambridgeport Roadway Improvements: (\$3 million) This project will realign street patterns in Cambridgeport from Massachusetts Avenue to Memorial Drive. Roadways to be affected include Sidney Street, Waverly Street, Albany Street and Brookline Street. This project is partially funded with private development funds from the University Park project. This is a "High Priority Project" with \$2.5 million in earmarked federal funding.

Route 53, Phase 2: (\$4 million) This project involves widening Route 53 in Hanover from Mill Street to Pond Street (1 mile in length). The existing 32-foot cross section will be widened to a 66-foot cross section with two lanes in each direction and a center turning lane. A four-way intersection will be realigned to have Pond Street/Route 53/Washington Street. This MassHighway project completed MEPA in January, 1999.

Bridge Street Bypass Road: (\$12.3 million) This project involves the construction of a new road along the North River in Salem. The approximately one mile bypass road begins at the Salem side of the Veteran's Memorial Bridge and connects to Bridge Street near the intersection with St. Peter Street. The bypass road will remove traffic from Bridge Street, allowing the city of Salem to make future pedestrian and aesthetic improvements to that street. The Bridge Street bypass road was part of an EIR and EIS conducted in the 1970s.

Crosby Drive: (\$3.5 million) Crosby Drive in Bedford will have a five-lane cross section with two travel lanes in each direction with a center turn lane for its entire length. MassHighway will

also construct a slip ramp to Route 3 Northbound. The project is at 25% design.

Middlesex Turnpike: (\$9 million) MassHighway will widen Middlesex Turnpike by one travel lane in each direction with a sixteen foot raised median from Route 62 in Bedford to Manning Road in Billerica.

Route 2/Crosby's Corner: (\$10.5 million) Grade separation of intersection of Route 2 (Cambridge Turnpike) and Route 2A (Concord Turnpike) in Concord. No added travel lanes. Safety improvements are included along 2-mile stretch of Route 2 from Bedford Road in Lincoln to Route 126 in Concord. The average daily traffic volumes on these sections of Route 2 and Route 2A were 51,000 and 11,000 vehicles, respectively, in 1996.

Dedham Street I-95 Southbound Ramp: (\$1.2 million) This project involves the construction of a new southbound on-ramp to I-95 from Dedham Street in Canton. There is no signal at the onramp. Future plans include a northbound off-ramp onto Dedham Street which would feature a signal.

Needham Street (Highland Avenue): (\$6,600,000) Reconstruction of Needham Street (Highland Avenue) from Centre Street in Newton to Interstate 95 (Route 128) in Needham.

Greenbush Extension of the Old Colony: (\$400 million) This extension would restore MBTA commuter rail service that was discontinued in 1959 with the opening of Route 3 South. Trains would originate at South Station and stops would be in Weymouth Landing, East Weymouth, West Hingham, Nantasket Junction, North Scituate and Greenbush (Scituate). Trains could also stop at existing commuter rail stations at JFK/UMass, Quincy Center and Braintree. The project was originally part of the restoration of the Plymouth and Middleborough/Lakeville branches. Those two branches were opened for service in Fall, 1997. Further environmental and historical preservation issues resulted in the delay of this project. As now envisioned this commuter rail project will include an 800 foot tunnel section

through the historic downtown section of Hingham. This project is a SIP commitment.

Arborway Green Line Service: (Cost to be determined) The MBTA is studying ways to resume Green Line service along the E branch from Heath Street stop to Arborway that was suspended in December, 1985. MBTA bus service (Route #39 from Back Bay to Forest Hills) is currently provided from Arborway to Heath Street. Any new Green Line service would need to be fully ADA compliant because it would constitute a new service according to federal guidelines governing ADA requirements. This restoration is a Central Artery/Tunnel and SIP commitment.

Green Line to Medford Hillside: (\$375,000,000; cost includes station construction and right of way improvements but not vehicles) The MBTA would extend Green Line trolley service to Medford Hillside. The extension begins at the relocated Lechmere Station in Cambridge, and continue along the Lowell commuter rail right of way through Somerville and Medford. The extension is 3.9 miles in length and there are four interim stations at Ball Square, Lowell Street, School Street, and Washington Street. 1994 ridership estimates were for 11,560 riders per day on the new extension, 3,660 of which were new transit users. This project is a SIP commitment. The extension to Medford Hillside is scheduled to be complete in 2011.

Red Line-Blue Line Connector: (Project cost is to be determined) This project would consist of an extension of the MBTA's Blue Line from Government Center/Bowdoin in Boston to the Charles Street Red Line station. The proposed Charles Street station work will not preclude a future Red Line-Blue Line connector. This connector was envisioned as providing a direct link between the only two transit lines that lack a direct station link in downtown Boston. This project is a Central Artery/Tunnel and SIP commitment. The Red Line-Blue Line Connector is scheduled to be complete in 2011.

Silver Line-Transitway, Section B: (\$713,000,000; cost includes construction of Transitway and new vehicles) The final phase of the MBTA's Silver Line project, and the one which allows integration between it and the South Boston Piers Transitway, is the construction of a new tunnel through Chinatown and the Leather District in Boston. This tunnel would roughly follow the alignment of Essex Street and would connect the end of the existing Silver Line tunnel at Boylston with Chinatown station and South Station. This provides another connection with the Orange Line as well as direct connections with Red Line subway, Transitway, Commuter Rail, Amtrak and intercity bus service. This phase of the Silver Line improves the level of service by utilizing the Green Line tunnel under Tremont Street with a portal at the Don Bosco High School building. The downtown end of the route would be adjusted to make stops at New England Medical and Boylston stations, allowing transfers to both the Orange and Green Lines. The Commonwealth has committed to apply for federal funding for this project by the end of 2004, and the project is to be complete before 2011.

Russia Ferry Wharf-South Station: (\$5 million) This project involves the construction of a docking facility and passenger shelter at Russia Wharf near South Station. The facility will provide ferry service between the South Station area and the Charlestown Navy Yard, complementing two other routes that serve the Navy Yard. Appropriate signage will also be provided to direct passengers from the Fan Pier and South Station area to the facility. The ferry terminal is a SIP commitment and will be built as part of one of the South Boston Piers Transitway contracts.

CAPITAL INVESTMENTS NOT AFFECTING THE TRAVEL MODEL

Green Line Vehicles-Type 8: (\$122 million)

The MBTA is in the process of receiving new Green Line vehicles from the manufacturer. The vehicles feature a low-floor design that allows mobility-impaired riders to access them at any of the Green Line stations that have been designated as key stations. The Type 8 vehicles also feature interior message displays, electronic exterior route indicators, and recorded station announcements. The MBTA will purchase 100 new Green Line vehicles.

Blue Line Vehicles:

(\$200 million) The MBTA will purchase new six-car trainsets for the Blue Line.

These vehicles can be used on the Blue Line once the reconstruction of stations has been completed. The Blue Line is the only of the three subway lines to operate only four-car trainsets during peak periods. Reconstruction of the existing stations involves the lengthening of platforms so that the longer trains can be accommodated. Once the platforms have been lengthened and the new trainsets have been purchased, the current Blue Line vehicles may be used to supplement existing vehicles on the Orange Line.

Low Emission Buses: (\$126 million) The MBTA is committed to the purchase of 314 compressed natural gas (CNG) buses for use systemwide. The purchase of the new vehicles is required by 2004 in the consent order agreed to between EOTC and EOEA in 2000 relating to the fulfillment of Central Artery project mitigation commitments.

Ashmont Stations Modernization: (\$83 million) The MBTA will reconstruct four stations on

the Ashmont branch of the Red Line. The four stations included in the project are Savin Hill, Field's Corner, Shawmut, and Ashmont--all located within the Boston neighborhood of Dorchester. In addition to the station work, some older bridges along the Ashmont branch will be rehabilitated.

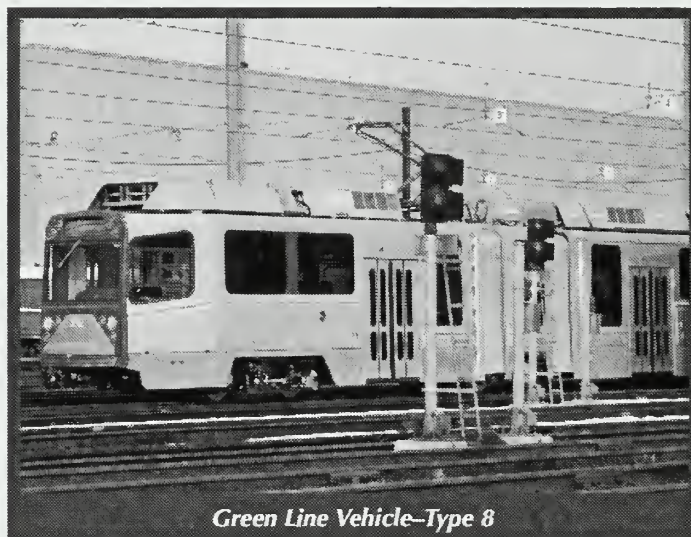
Charles Street Station Modernization: (\$27 million) This project involves the reconstruction

of the Charles Street station on the Red Line. Goals of the project are to make the station accessible and to improve its relationship to the surrounding Charles Circle/Cambridge Street area.

Bus Maintenance Facilities: (\$80 million) The MBTA's purchase of 314 new CNG buses marks the

first time this type of vehicle will be used in the system. In order to service these alternative fuel vehicles, the MBTA will build new CNG maintenance facilities.

Automatic Fare Collection: (\$120 million) This project involves complete replacement of the MBTA's current fare collection equipment on all subway, trolley, trackless trolley and bus vehicles. The new automatic fare collection (AFC) equipment will provide several benefits to the MBTA and its riders. In addition to the current monthly pass system, riders will be able to purchase stored value cards. This fare media acts as a debit card, allowing passengers to use any mode in the system provided that the dollar value remaining on their card is sufficient to pay the fare. Value can be added to stored value cards after they are purchased, either at fare collector booths or at automatic vending machines (AVM). Stored value cards are beneficial to less frequent riders because they can have the convenience of a pass without having to invest in an unlimited ride monthly



Green Line Vehicle-Type 8

pass. They also reduce the amount of actual cash transactions in the system. AFC turnstiles will be better able to provide accurate data on fare collection and revenue for the MBTA. Since AFC turnstiles have both read and write capabilities, the MBTA can use them as a paperless method of providing free transfers between buses. Another fare policy that can be implemented with AFC is the distance-based fare.

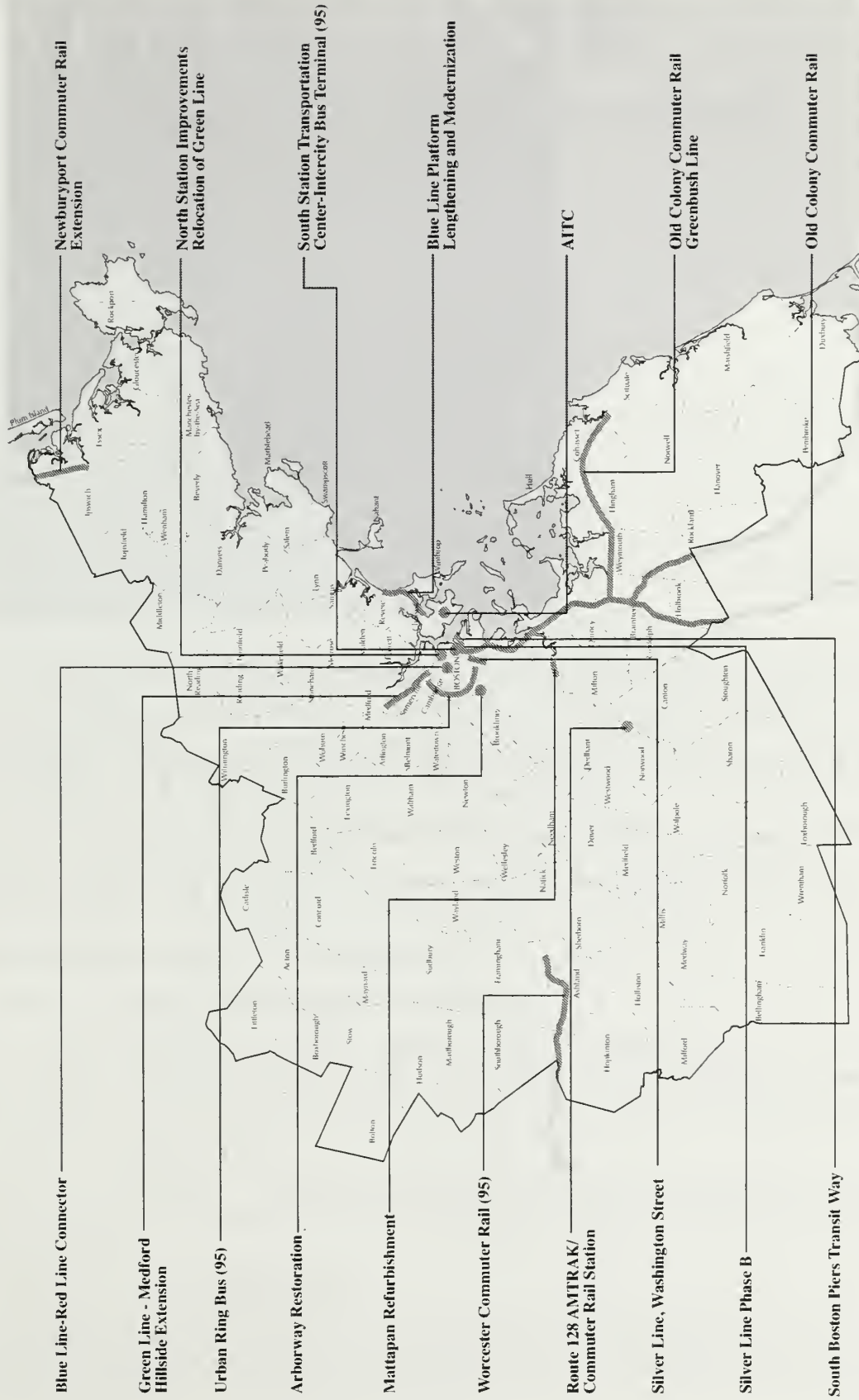
Green Line Accessibility: (\$124 million) This project involves the completion of the Green Line's key station program. The key station program will put the Green Line in compliance with the Americans with Disabilities Act (ADA). Copley, Arlington, and Government Center stations in the central subway will be made accessible. In addition, several key stations along the Green Line's surface routes will be made accessible through the construction of elevated platforms.

AMTRAK Service to Portland, Maine: In 2001, AMTRAK will reintroduce service between Boston and Portland, Maine. The new service will use North Station as its Boston terminus. Other stops include Haverhill, Massachusetts; Exeter, Dover and Durham, New Hampshire; and Old Orchard Beach, Wells and Saco, Maine. Travel time between Boston and Portland will be approximately two and half hours.

1995 Base Case and Projects for 2025 Build Highway



MAP A-2 1995 Base Case and Projects for 2025 Build Transit







APPENDIX

B

GLOSSARY

AACT (Access Advisory Committee to the MBTA) - Consumer group that meets with MBTA staff to discuss the transportation concerns of people with disabilities and to ensure ADA compliance.

ADA (Americans with Disabilities Act) - Federal legislation prohibiting discrimination on the basis of disability, requiring accessible transportation services. See Paratransit.

Arterial - A class of street or highway serving major through traffic, usually on a continuous route.

AWDT (Average Weekday Daily Traffic) - The average number of vehicles that pass a specified point during a 24-hour period.

BMS - Bridge Management System (see Management System)

BTP&D - Bureau of Transportation Planning and Development

CAAA (Clean Air Act Amendments of 1990) - Federal law that sets allowable levels, which are known as National Ambient Air Quality Standards (see NAAQS), for various pollutants. Where these standards are not attained, officials must take specified actions within a set time frame or face potential sanctions, such as loss of federal highway funds.

CARAVAN for Commuters, Inc. - A private, non-profit corporation that promotes ridesharing, provides information on transportation alternatives to commuters, and assists in establishing transportation management associations.

CA/THT - Central Artery/Third Harbor Tunnel

CDC (Concentrated Development Center) - A land-use designation used to encourage compact, higher density development in areas that have adequate public facilities including transportation, sewer, water, parks, and recreation.

CINCH (Capacity of Intersections CTPS' HCM [Highway Capacity Manual]) - A micro-computer program used for traffic analysis of signalized and unsignalized intersections to provide a quick, accurate analysis of intersection capacity.

Clean Cities Steering Committee - A public/private committee established to provide incentives for public agencies in the Boston metropolitan area to acquire alternative fuel vehicles and to undertake other activities to support an increase in the number of alternative fuel vehicles.

CMAQ (Congestion Management/Air Quality) - TEA-21 program that provides funding for air quality non-attainment areas to implement transportation projects that will contribute to an area's compliance with National Ambient Air Quality Standards.

CMS - Congestion Management System (see Management System)

CO - Carbon Monoxide

Conformity - The requirement that the state or metropolitan transportation plan, programs, and projects are consistent with the purpose of the State Implementation Plan (SIP). The CAAA does not permit federal approval of funding of any project that does not meet this test. See SIP.

Consultation - Means that one party confers with another identified party and, prior to taking action(s), considering that party's views. (Source: U.S. DOT, "Statewide Planning; Metropolitan Planning; Final Rules," October 28, 1993.)

Cooperation - Means that the parties involved in carrying out the planning, programming and management systems processes work together to achieve a common goal or objective. (Source: U.S. DOT, "Statewide Planning; Metropolitan Planning; Final Rules," October 28, 1993.)

Coordination - Means the comparison of the transportation plans, programs, and schedules of one agency with related plans, programs and schedules of other agencies or entities with legal standing, and adjustment of plans, programs and schedules to achieve general consistency. (Source:

U.S. DOT, "Statewide Planning; Metropolitan Planning; Final Rules," October 28, 1993.)

CORSIM - An FHWA-sponsored computer program used to analyze the operational performance of freeway and arterial roadway networks.

CTPS (Central Transportation Planning Staff) - An interagency staff created by the MPO to carry out the general transportation planning activities and provide the member agencies with analyses on the work activities contained in this document.

DBE (Disadvantaged Business Enterprise) - An official designation applied to a business that is primarily owned and controlled by a person from a class that has historically suffered from discrimination in the workplace. DBEs are eligible for various contract preferences or set-asides under the state's public bidding process.

DEIS - Draft Environmental Impact Study

DEP - Department of Environmental Protection

DRAM/EMPAL - A commonly used model, developed by Dr. Stephen Putnam of the University of Pennsylvania, that is used to forecast how households and employment might be allocated around a region in some future years in response to an assumed transportation network.

EIS (Environmental Impact Statement) - Document that studies all likely impacts that will result from major federally assisted programs. Impacts include those on the natural environment, as well as impacts on the economy and society, and those on the built environment of historical and aesthetic significance.

EMME/2 - A software package, developed by INRO Consultants, that is designed for highly sophisticated travel modeling.

EOTC (Executive Office of Transportation and Construction) - A cabinet-level agency that sets state policies and plans for all modes of transport and that oversees public transit services, general aviation programs, and the state and local highway network. Established under M.G.L. Chapters 6A and 161A.

EPA - Environmental Protection Agency

FAA - Federal Aviation Administration

FAC (Massachusetts Freight Advisory Council)

- A public/private committee sponsored by EOTC, which works to improve coordination of statewide freight movement.

FEIR - Final Environmental Impact Review

FHWA - Federal Highway Administration

FRA - Federal Railroad Administration

FTA - Federal Transit Administration

GEIR - Generic Environmental Impact Review

GIS - Geographic Information System

HOV (high-occupancy vehicle) - Applied to vehicles carrying two or more people. Roads may have lanes reserved for HOV use, such as car-pools, vanpools and buses.

HPMS - Highway Performance Monitoring System

HSMP - Highway Safety Management Program (see Management System)

IMS - Intermodal Facilities and Systems Management System (see Management System)

Intermodal - Planning that reflects a focus on connectivity between modes as a means of facilitating linked tripmaking. It emphasizes connections, choices, coordination, and cooperation.

ISTEA (Intermodal Surface Transportation Efficiency Act of 1991) - Previous Federal surface transportation legislation that expired on October 1, 1997.

ITS (Intelligent Transportation System) - A program that seeks to develop or apply electronics, communications, or information processing technologies to improve the efficiency and safety of surface transportation systems.

IVHS (Intelligent Vehicle Highway Systems) - Computer and communications technology that provides real-time information to operators of vehicles about transportation system conditions.

Also includes technologies that identify, monitor, or control vehicles.

JRTC (Joint Regional Transportation Committee) - Citizen group that advises the MPO and its six signatory agencies on transportation issues and reviews the Transportation Plan, TIP, and the UPWP.

Land Use - The purpose for which land or the structures on the land are being utilized: for example, commercial, residential, retail. Also used as a description of activities found throughout an urban area.

MAC (Massachusetts Aeronautics Commission) - Agency that is responsible for airports, mostly municipal, not managed by Massport. Established under M.G.L. Chapter 6, § 57.

Major Metropolitan Transportation Investment - A highway or transit improvement of substantial cost that is expected to have a significant effect on capacity, traffic flow, level of service, or mode share at the transportation corridor or sub-area scale. (Source: U.S. DOT, "Statewide Planning; Metropolitan Planning; Final Rules," October 28, 1993.)

Management System - A systematic process, designed to assist decision makers in selecting cost effective strategies/actions to improve the efficiency and safety of, and protect the investment in the nation's infrastructure. As required by Section 303 of ISTEA, states (in coordination with metropolitan areas) must develop and begin implementing six management systems: congestion, intermodal, public transportation, pavement, bridges, and safety.

MAP (Mobility Assistance Program) - A program to provide capital assistance to public agencies and private, non-profit corporations for the purchase of vehicles and related equipment in the provision of transportation services to people who are elderly and disabled.

MAPC (Metropolitan Area Planning Council) - Regional comprehensive planning agency for the Boston metropolitan area, covering 101 communities. Comprised of officials from cities, towns,

and state agencies, and independent gubernatorial appointees. Established under M.G.L. Chapter 40B, § 24.

Massport (Massachusetts Port Authority) - Agency charged to operate and develop major commercial maritime and aviation facilities and the Tobin Bridge. Created as an independent authority in M.G.L. Chapter S73, § 2.

MBE/WBE - Minority-owned/women-owned business enterprise.

MBTA (Massachusetts Bay Transportation Authority) - Authority that provides mass transit service in eastern Massachusetts. Established under M.G.L. Chapter 161B.

MBTA Advisory Board - Represents 175 cities and towns in the MBTA district. Powers include approval of the MBTA budget and the Program for Mass Transportation (PMT), and review of the MBTA's capital plan and fare policy statement.

MDC (Metropolitan District Commission) - Agency that maintains 15,000 acres of park land, numerous public beaches, and 650 miles of parkways. Established under M.G.L. Chapter 28, § 1.

MEPA - Massachusetts Environmental Policy Act

MetroPlan - The long-range land-use plan for the Boston region, developed by MAPC which seeks to direct development primarily to Concentrated Development Centers (CDCs). A map of CDCs is in chapter 2.

MHD (Massachusetts Highway Department) - Agency responsible for the design, construction, and maintenance of state highways and bridges. Established under M.G.L. Chapter 16, § 2.

MIS - Major Investment Study

Mode - A particular means of transportation (e.g., rail, automotive, bicycle, walking).

MOU (Memorandum of Understanding) - An agreement between public agencies. As an example, the Boston MPO was recently restructured, through an MOU between its member agencies, to include additional local participation in the decision-making process.

MPO (Metropolitan Planning Organization) - A forum for cooperative transportation decision making for a metropolitan area. The Boston MPO is comprised of seventeen members. The eight permanent members are EOTC (Chair), MBTA Advisory Board, MBTA, MHD, Massport, MAPC, MTA and the city of Boston. In addition, three cities and three towns are elected members of the MPO. Currently they are the cities of, Everett Newton and Peabody; and the towns of Bedford, Framingham, and Hopkinton. The ex officio members are: the Federal Highway Administration, the Federal Transit Administration and the Joint Regional Transportation Committee.

MTA (Massachusetts Turnpike Authority) - Agency responsible for the operation of the Massachusetts Turnpike (a component of Interstate 90) and the Sumner, Callahan and Ted Williams Harbor Tunnels. Established under M.G.L. Chapter S75, § 3.

Multimodal - Planning that reflects consideration of more than one mode to serve transportation needs in a given area and that is included in the meaning of intermodal.

NAAQS (National Ambient Air Quality Standards) - Federal standards that set allowable concentrations and exposure limits for ozone and CO.

NHS - National Highway System

Nonattainment area - A geographic region that the U.S. EPA has designated as not meeting the NAAQS. The Boston area has been designated as being in serious nonattainment for ozone and moderate nonattainment for CO. See NAAQS.

NOx - Nitrogen Oxide

Ozone - A gas that is not a direct emission from transportation sources, but is formed when VOCs and NOx from car exhausts and industrial emissions combine in the presence of sunlight. Ground-level ozone is associated with smog conditions and initiates damage to lungs, trees, crops, and materials.

Paratransit - A demand-responsive system that applies to a variety of smaller, flexibly scheduled and routed transportation services using low-capacity vehicles. Used by persons, such as the elderly and other persons with disabilities, for whom use of standard mass transit services may prove difficult.

PL Funds - FHWA planning funds to be used to support MPO 3C planning efforts.

PMS - Pavement Management System (see Management System)

PMT (Program for Mass Transportation) - The MBTA's long-range capital plan, developed by EOTC and approved by the MBTA Advisory Board with full public involvement.

PROJIS - MHD's project information system, used for tracking projects from concept approval to advertisement.

Regionally Significant Project - A project (other than projects that may be grouped in the STIP/TIP) that is on a facility which serves regional transportation needs and would normally be included in the modeling of a metropolitan area's transportation network, including, as a minimum, all principal arterial highways and all fixed guideway transit facilities that offer a significant alternative to regional highway travel. (Source: U.S. DOT, "Statewide Planning; Metropolitan Planning; Final Rules," October 28, 1993.)

Section 5303 Funds - FTA funds to be used to support MPO planning activities.

Section 5309 Funds - FTA discretionary funds that may be used to support MPO planning activities.

SIP (State Implementation Plan) - A document that contains procedures to comply with the NAAQS, as specified in the CAAA. Prepared by states and submitted to the U.S. EPA for approval.

SOV - Single-occupant vehicle

SPR Funds - FHWA Statewide Planning and Research funds that may be used for metropolitan

and statewide transportation planning. Formerly known as HPR Funds.

SSC (Sub-Signatory Committee of the MPO) - Designees of MPO members. They review and approve distribution of reports and other documents related to the Transportation Plan, TIP, and UPWP.

STIP (Statewide Transportation Improvement Program) - A staged, multi-year, statewide, inter-modal program of transportation projects which is consistent with the Statewide transportation and planning processes and metropolitan plans, TIPs and processes. (see TIP) (Source: U.S. DOT, "Statewide Planning; Metropolitan Planning; Final Rules," October 28, 1993.)

STP (Surface Transportation Program) - A highway funding category established by ISTEA and continued in TEA-21. STP funds may be used for bridge projects, highway projects, bicycle and pedestrian projects, highway safety projects, and enhancement projects. STP funds may also be transferred to FTA and converted into transit funding.

TANF- Transitional Aid to Needy Families

TCM (Transportation Control Measure) - Actions, which are usually found in a SIP, that improve traffic flow, or reduce vehicle use or congestion with the objective of reducing air pollutant emissions. See SIP.

TDM (Transportation Demand Management) - In its most general form, any action or actions that attempt to control or alter existing travel patterns or use. Included in this group are a wide range of strategies, such as promoting ridesharing, requiring alternative workhours or flextime, or increasing travel costs for single-occupant vehicles.

TEA-21 (Transportation Equity Act for the 21st Century) - Federal surface transportation legislation that authorizes federal-aid programs for transit systems and highways for a period of six years.

TE/SIP - Transportation Element of the State Implementation Plan

“3C” process - A continuing, comprehensive transportation planning process carried out cooperatively by states and local communities.

TIP (Transportation Improvement Program) - A staged, multi-year, intermodal program of transportation projects which is consistent with the metropolitan transportation plan. (Source: U.S. DOT, “Statewide Planning; Metropolitan Planning; Final Rules,” October 28, 1993.)

TMA (Transportation Management Area) - An urbanized area over 200,000 in population. Within a TMA, all transportation plans and programs must be based on the 3C process. The TMA boundary affects the responsibility for the selection of transportation projects that receive

federal funds. (Source: U.S. DOT, “Statewide Planning; Metropolitan Planning; Final Rules,” October 28, 1993.)

Transportation Plan - The official intermodal transportation plan that is developed and adopted through the metropolitan transportation planning process for the metropolitan area. The plan must give consideration to fifteen factors, including land use, financial resources, environmental impacts, and the management systems.

UPWP (Unified Planning Work Program) - Document required by the U.S. DOT Metropolitan Planning regulations that contains a description of all proposed transportation-related planning activities and air quality planning activities.

VOCs - Volatile Organic Compounds

APPENDIX C

OTHER PLANNING EFFORTS



Numerous plans and studies were used in the development of this Regional Transportation Plan. This appendix provides a brief summary of documents that influenced its development and how to obtain them.

Source Document: The 1997 Transportation Plan Annual for the Boston Region, April 1997

Undertaken by: The Boston Metropolitan Planning Organization and executed by the Central Transportation Planning Staff

Summary: The Plan defines the goals and objectives of the regional transportation planning system for 101 cities and towns in the metropolitan Boston region. It analyzes existing conditions, assesses transportation needs and proposes a financially constrained set of projects to meet those needs.

The document also contains the results of an air quality analysis that was conducted to demonstrate conformity with the Clean Air Act amendments of 1990.

Contact: Central Transportation Planning Staff
Certification Activities Group
State Transportation Building
10 Park Plaza, Suite 2150
Boston, MA 02116
Telephone: 973-7100
E-mail: public information@ctps.org

Source Document: The 2000 Congestion Management System (CMS) Report

Undertaken by: The Boston Metropolitan Planning Organization and executed by the Central Transportation Planning Staff

Summary: The CMS identifies mobility problems in the Boston region and demonstrates alternative improvements that can be considered by decision-makers for project planning, prioritizing and programming.

Contact: Efi Pagitsas
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10 Park Plaza, Suite 2150
Boston, MA 02116
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Source Document: The FY 2001-2006 Transportation Improvement Program (TIP) and Air Quality Conformity Determination

Undertaken by: The Boston Metropolitan Planning Organization and executed by the Central Transportation Planning Staff

Summary: This is a document that sets forth a six-year program of transportation construction projects for the Boston Region. Federal funding sources for specific projects are identified for the first three years.

Like the Transportation Plan, the TIP also contains the results of an air quality analysis that was conducted to demonstrate conformity with the Clean Air Act amendments of 1990.

Contact: Certification Activities Group
Central Transportation Planning Staff
State Transportation Building
10 Park Plaza, Suite 2150
Boston, MA 02116
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E-mail: public information@ctps.org

Source Document: The 1999 Annual Mobility Report: Information for Urban America

Undertaken by: The Texas Transportation Institute and the Texas A&M University System

Summary: This report provides data on the performance of elements of 68 urban-area transportation systems. It includes travel, demographic, facility and operational performance statistics from 1982 to 1997. The report is designed to present technical information to non-technical audiences.

Contact: Web address: <http://mobility.tamu.edu>

Source Document: Accessing the Future: The Intermodal Policy Plan for the Commonwealth of Massachusetts, 1995

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- Undertaken by:** The Executive Office of Transportation and Construction and the Bureau of Transportation Planning and Development
- Summary:** This is a three part document, the first of which focuses on the mission of the state's transportation system, as well as the policies, goals, and objectives that need to be accomplished to complete that mission.
- Part Two describes the current transportation system and the transportation planning process in Massachusetts and includes a summary of the regulatory framework within which transportation planning must be accomplished. The second part also discusses the role transportation plays in the protection and enhancement of the environment, the need to fund our transportation system in an era of fiscal constraint, and the implementation of management systems.
- Contact:** Karen Pearson
Bureau of Transportation Planning and Development
State Transportation Building
10 Park Plaza Suite 4150
Boston, MA 02116
Telephone: 973-7335
- Source Document:** Bike to the Sea Feasibility Study, August 1996
- Undertaken by:** MassHighway and executed by the Central Transportation Planning Staff
- Summary:** This study has determined that it is feasible to build a bicycle trail on the Saugus Branch, an MBTA- owned right-of-way that begins in Everett, goes through Malden, the northwest corner of Revere and Saugus, and ends in Lynn. It examines accident data, traffic volumes, and population densities by community and explores issues relevant to the bicycle mode, such as the occurrence of at-grade intersections.
- Contact:** Cathy Buckley Lewis
Central Transportation Planning Staff
10 Park Plaza, Suite 2150
Boston, MA 02116
Telephone: 973-7118
E-mail: cbucklewis@ctps.org
- Source Document:** Boston- Logan Airport 1998 Annual Update, October 1999
- Undertaken by:** The Massachusetts Port Authority and executed by VHB/Vanasse Hangen Brustlin, Inc. in association with Harris Miller Miller & Hanson, Inc., URS Greiner, Inc., Flight Transportation Associates, Inc., and Simat, Hellieson & Eichner, Inc.
- Summary:** This report presents a series of status updates on conditions and environmental mitigation measures at Logan Airport for the categories of ground transportation, noise, air quality, and water quality. It provides a "snapshot" of 1998 conditions at Logan Airport as compared to those of 1997. The 1998 Annual Update also documents the status of airport facilities, modernization, operating efficiency, and progress on mitigation efforts for that year.
-

Contact: Director of Environmental Permitting
Massachusetts Port Authority
One Harborside Drive
East Boston, MA 02128
Telephone: (617) 561-1600
Fax: (617) 561-1609

Source Document: The Central Artery/Tunnel Project Finance Plan, October 2000

Undertaken by: The Massachusetts Port Authority

Summary: This Finance Plan presents the integrated cost, schedule, and funding forecasts for the Central Artery/Tunnel Project based on information as of June 30, 2000 and the results of a comprehensive cost and schedule evaluation. It was prepared in accordance with Federal Highway Administration guidelines establishing base cost and schedule estimates to which this and all other future Finance Plans will be compared. It includes updated budget assumptions, project financing and revenues, a cost and revenue history, and cost trends.

Contact: Massachusetts Turnpike Authority
State Transportation Building
10 Park Plaza, Suite 4160
Boston, MA 02116
Telephone: 248-2800
Web address: www.bigdig.com

Source Document: Congestion in the MetroWest Area: Issues and Potential Responses

Undertaken by: MassHighway and executed by the Central Transportation Planning Staff in cooperation with the MetroWest Growth Management Committee and MetroWest community planners

Summary: This is a Phase I report on the MetroWest Subregional Area Study. It presents a "snapshot" of existing growth and travel patterns of the nine communities in the Metro West area. (Ashland Framingham, Marlborough, Natick, Southborough, Sudbury, Wayland, Wellesley, and Weston) It is intended to serve as a background for identifying and evaluating actions that have the potential to provide some degree of congestion relief. It also identifies a short-list of planning tasks for the second phase of the study, which is expected to be completed in December.

Contact: Mary McShane
Central Transportation Planning Staff
10 Park Plaza, Suite 2150
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E-mail: marymcs@ctps.org

Source Document: The Demographics of Commuting in Greater Boston, August 1998

Undertaken by: The Boston Metropolitan Planning Organization

Summary: This Report explains the patterns of commuting seen in the Boston region by looking at the area's demographic trends since 1950. The report defines the "Boston Metropolitan Planning Organization Commuter Source Area," examines trends in population, housing and employment, and studies actual commuting patterns, highlighting the difference between older cities and newly developed suburbs.

Contact: Lee Morrison
Central Transportation Planning Staff
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Boston, MA 02116
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Source Document: Gloucester Harbor Plan, March 1999

Undertaken by: The Gloucester Harbor Plan Committee and executed ICON architecture inc. in association with Fay Spofford and Thorndike, Inc, FXM Associates, New Atlantic Development, Seafood Data Search and Regina Villa Associates

Summary: The Plan outlines a program of projects, initiatives, development opportunities, and studies to be implemented in phases over a five-to-seven-year period. The program is designed to maintain Gloucester Harbor infrastructure and improve navigation, support needed development, strengthen the traditional port, including facilities and businesses on historic piers, and develop cultural assets. The plan recommends several key transportation projects to improve the land side transportation network in the Harbor area, including the redesign and replacement of the Blyman Street Bridge.

Contact: Dale T. Brown
City of Gloucester Harbor Plan Committee
2 State Fish Pier
Gloucester, MA 01930
Telephone: (978) 281-2103
Fax: (978) 281-2103

Source Document: Identification of Massachusetts Freight Issues and Priorities, November 1999

Undertaken by: The Massachusetts Freight Advisory Council (MFAC) and executed by MassHighway and Louis Berger Associates

Summary: This report documents an effort to assist the MFAC to identify and prioritize freight transportation issues and concerns which should be addressed to contribute to a more efficient and competitive freight transportation system. The effort consisted of outreach to a focus group through meetings that were held with the freight community beginning in October 1997 and ending in November 1998. The report summarizes the results of that process.

Contact: Mark Berger, Project Manager
MassHighway Planning

State Transportation Building
10 Park Plaza, Suite 4150
Telephone: (617) 973-7340

Source Document: ISTEA and Intermodal Planning Concept, Practice and Vision
Special Report 240, December 1992

Undertaken by: The Transportation Research Board

Summary: This compendium presents the proceedings of a conference held in December 1992. Its purpose was to review the evolution of planning and funding the U.S. transportation system, identify planning mechanisms developed in the Intermodal Transportation Efficiency Act, explore ways to achieve a more economically and environmentally efficient transportation system, and assess how they should be integrated into the planning process.

Contact: Transportation Research Board
National Research Council
2101 Constitution Avenue, NW
Washington, D.C. 20418

Source Document: Logan Airside Improvements Planning Project
Environmental Impact Statement/Report, February 1999

Undertaken by: The Massachusetts Port Authority and the Federal Aviation Administration

Summary: This study demonstrates the benefits of proposed airside taxiway improvements and modifications to Runway 14-32 at Logan Airport.

It also presents the results of peak period pricing analyses as well as case studies that demonstrate a large reduction in taxiway delays that translate into environmental benefits for the airport in terms of reduced ground noise and air quality impacts.

Contact: Director of Environmental Permitting
Massachusetts Port Authority
One Harborside Drive
East Boston, MA 02128
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Fax: (617) 561-1609

Source Document: The Marine Industrial Park Maser Plan Environmental Impact Report,
July 1996 and Master Plan Update, July 1998

Undertaken by: The Boston Redevelopment Authority/Economic Development Industrial Corporation and executed by Fort Point Associates

Summary: The Master Plan of July 1996 presents existing conditions and discusses future plans for South Boston's Marine Industrial Park. It describes the Park's role in the Port of Boston and the Commonwealth and its current land use and infrastructure. It presents an economic development plan that identifies specific expansion

opportunities and foreign trade opportunities, as well as financing and marketing strategies. The Plan also explores planning issues and the existing and proposed regulatory framework, and sets forth an implementation strategy.

The Master Plan Update of July 1998 presents information on new projects and planning efforts related to the 1996 plan, documents new commitments in the Master Plan resulting from public comment. In addition it clarifies regulatory approaches, provides new zoning boundaries, limits and use definitions, outlines a process for approving the Master Plan and provides responses to all comments received on the initial Master Plan.

Contact: Linda Haar, Director of Planning
Boston Redevelopment Authority/Economic Development Industrial Corporation
One City Hall Square
Boston, MA 02201-1007
Telephone: 722-4300

Source Document: The Marine Terminal Optimization Program, January 1996

Undertaken by: The Massachusetts Port Authority Maritime Division

Summary: This report describes an optimization program that consolidates similar operations on dedicated terminals, thereby gaining economies of scale, increasing overall port efficiency and customer service and improving financial performance. The program began in 1993 and includes market assessment, infrastructure requirements, a feasibility analysis and a management analysis.

Contact: Ralph F. Cox, Maritime Director
Massachusetts Port Authority
One Harborside Drive Suite 200 S
East Boston, MA 02128
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Source Document: The draft MBTA FY'01–GY'06 Capital Investment Program

Undertaken by: Massachusetts Bay Transportation Authority (MBTA)

Summary: The MBTA created the Capital Investment Program to provide an understanding of the Authority's planned capital expenditures for the current year and a five-year planning horizon as well as to outline the need for future capital investment. The program bundles like capital efforts together into structured projects and further in programmatic areas. The intent is to provide the reader with an easily understood and followed resource guide to the MBTA's capital program.

Contact: MBTA Budget Office
State Transportation Building
10 Park Plaza, Third Floor
Boston, MA 02116
Telephone: 222-3127
Web address: www.mbta.com

Source Document: The Minuteman–Charles River Bikeway Connector Feasibility Study, November 1996

Undertaken by: MassHighway and executed by the Central Transportation Planning Staff

Summary: This study examines the feasibility of the Dr. Paul Dudley White Bicycle Path, which goes from the Charles River Dam in Cambridge to Watertown Square, and the Minuteman Commuter Bikeway, which goes from the Alewife area of Cambridge to Bedford. It defines existing conditions, presents bicycle and pedestrian accident data, and provides suitability ratings for study area roadways. The study explores both on-road and off-road alternatives and recommends on-road alternatives.

Contact: Cathy Buckley Lewis
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10 Park Plaza, Suite 2150
Boston, MA 02116
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Source Document: The New Program for Mass Transportation (PMT), March 1994

Undertaken by: The Executive Office of Transportation and executed by the Central Transportation Planning Staff

Summary: The PMT is the mass transportation plan for the Boston metropolitan area. More specifically it is a long-range plan for construction, reconstruction, or alteration of facilities for mass transportation within the MBTA district together with a schedule for implementation and financial estimates of cost and revenues. It identifies and recommends projects that will result in a cost-effective system that serves the greatest number of people in a way that respects the environment and enhances responsible development.

Contact: Central Transportation Planning Staff
Certification Activities Group
State Transportation Building
10 Park Plaza, Suite 2150
Boston, MA 02116
Telephone: 973-7100
E-mail: public information@ctps.org

Source Document: The Port of Boston Economic Development Plan, March 1996

Undertaken by: The Boston Redevelopment Authority/Economic Development Industrial Corporation and the Massachusetts Port Authority

Summary: The Port of Boston Plan examines all aspects relating to the Port of Boston. It examines ways to promote and encourage development of the seaport economy, preserve essential Port properties for active maritime uses, maintain maritime industrial jobs, provide waterside and landside public infrastructure to support

growth. It also explores the port as a component of the tourist trade and how to redevelop appropriate portions of the Port for a mixed harborwide economy.

Contact: Linda Haar, Director of Planning
Boston Redevelopment Authority/Economic Development Industrial Corporation
One City Hall Square
Boston, MA 02201-1007
Telephone: 722-4300

Source Document: Salem Harbor Master Plan, May 1999

Undertaken by: The City of Salem and executed by the Cecil Group, in association with Byrne McKinney & Associates, Inc., Nucci Vine Associates, Inc., Management Strategies Limited, Vanasse Hangen Brustlin, Inc. Urban Harbors Institute, Impact Research Associates, The Harbor Consultancy International, and Bermello, Ajamil & Partners, Inc.

Summary: This plan for Salem Harbor presents a framework for guiding development and preservation choices for the city of Salem. It provides an important basis for the City and the Commonwealth of Massachusetts to employ shared approaches to the development and regulation of waterfront areas that are subject to public rights and interests. Importantly, the Harbor Plan outlines the implementation requirements associated with achieving a vision for Salem Harbor.

Contact: Planning Director
City of Salem
93 Washington Street
Salem, MA 01970
Telephone: (978) 745-9595

Source Document: South Boston Transportation Study, April 2000

Undertaken by: The Boston Transportation Department in association with the Boston Redevelopment Authority and the Massachusetts Port Authority and executed by Louis Berger & Associates.

Summary: This study proposes a comprehensive, multi-modal transportation vision for all of South Boston, with consideration of general traffic, public transportation, truck traffic, parking, pedestrians and bicycles. It is meant to serve as a guide for assessing the overall status of land development and transportation in South Boston and as a planning tool for South Boston residents, public officials, land developers, and advocates.

The study examines the cumulative impact of all the land development envisioned for the South Boston Waterfront. It reviews the current transportation system in contrast to the post Central Artery/Tunnel system and analyzes the effects of varying levels of land development on it. It also identifies issues that may create problems and proposes alternatives for addressing them.

Contact: Ned Codd
Boston Transportation Department

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Boston, MA 02118
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E-mail: ned.codd@ci.boston.ma.us

Source Document: Suburban Public Transportation

Undertaken by: The Metropolitan Planning Organization and executed the Central Transportation Planning Staff

Summary: This paper examines the theory and practice of public transportation in suburban areas. It considers the concept of “the suburbs”, highlighting the variety of environments that make up the suburban portion of a metropolitan area describes public transportation and the environments in which they are successful and discusses the factors that a mode choice (driving alone, car-pool/van pool or transit.)

The report also considers transit service expansion in the suburbs in three segments of the travel market: suburb-to-suburb, city-to-suburb, and intrasuburb, and analyzes the short-term and long-term impacts of the potential service expansions.

Contact: Lee Morrison
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Source Documents: The Unified Planning Work Programs (UPWP) from 1995 to 2001

Undertaken by: The Boston Metropolitan Planning Organization (MPO) and executed by the Central Transportation Planning Staff

Summary: The UPWP describes transportation planning projects to be undertaken in the Boston region during a given fiscal year by the MPO transportation agencies and colleges and universities. The document serves two purposes. The first is to provide information to the general public, local communities and government officials about all surface transportation planning projects to be conducted in the area. The second is to provide complete budget information for those projects to be conducted by the MPO.

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APPENDIX D

SUPPLEMENTAL INFORMATION FOR THE AIR QUALITY CONFORMITY DETERMINATION

Appendix D provides the technical information used in determining the conformity determination for the Boston MPO 2000 Transportation Plan.

Table D-1 shows the inputs that were used in the MOBILE5A-H emission model which calculates emission factors for the pollutants that must be analyzed – volatile organic compounds (VOC), nitrogen oxides (NO_x), and carbon monoxide (CO).

Table D-2 provides the actual emission factors that were used to calculate emissions associated with the 2000 Transportation Plan.

Table D-3 is a status report of the Transportation Control Measures (TCMs) required in the Boston MPO area that are included in the State Implementation Plan (SIP). A requirement of the conformity determination is to ensure that all TCMs be implemented in a timely fashion. TCMs have been required in the Boston MPO area in SIP submissions in 1979, 1982, and as mitigation to the Central Artery.

Table D-4 lists categorically exempt projects – projects which are eligible for federal funding that have no impact on regional emissions.

Table D-5 presents a summary of off-model emissions from the MBTA buses, commuter rail train emissions, and commuter boat emissions.

Table D-1
MOBILE 5 A-H INPUTS – YEAR 1995 CONDITIONS

	VOCs	Winter CO	NOx
Tampering rates	Mobile 5A-H defaults	Mobile 5A-H defaults	Mobile 5A-H defaults
VMT mix	VMFLAG 1, Mobile5A-H defaults	VMFLAG 1, Mobile5A-H defaults	VMFLAG 1, Mobile5A-H defaults
Annual Mileage Accumulation and/or Registration Distribution by Age	MYMRFG 3 Default accumulation rates/Massachusetts specific registration distribution	MYMRFG 3 Default accumulation rates/Massachusetts specific registration distribution	MYMRFG 3 Default accumulation rates/Massachusetts specific registration distribution
Modified Basic Exhaust Emission Rates (BERs)	Mobile 5A-H defaults	Mobile 5A-H defaults	Mobile 5A-H defaults
Inspection and Maintenance program start year	IMFLAG 2 - Single program 1983	IMFLAG 2 - Single program 1983	IMFLAG 2 - Single program 1983
stringency level	12%	12%	12%
first model year subject to program	1980	1980	1980
last model year subject to program	1994	1994	1994
waiver rate pre-1981	1%	1%	1%
waiver rate 1981-present	1%	1%	1%
compliance rate	80%	80%	80%
program type	Computerized inspection and repair annual	Computerized inspection and repair annual	Computerized inspection and repair annual
inspection frequency	LDGV,LDGV1,LDGV2	LDGV,LDGV1,LDGV2	LDGV,LDGV1,LDGV2
vehicles subject to inspection	LDGV,LDGV1,LDGV2	LDGV,LDGV1,LDGV2	LDGV,LDGV1,LDGV2
test type	idle	idle	idle
alternative credits	no alternative credits	no alternative credits	no alternative credits
transient test	not modeled	not modeled	not modeled
purge system check	not modeled	not modeled	not modeled
presure check	not modeled	not modeled	not modeled
Exhaust Emission Correction Factors	no corrections	no corrections	no corrections
Anti-tampering program	ATPFLAG 1 - not modeled	ATPFLAG 1 - not modeled	ATPFLAG 1 - not modeled
Refueling Emission Factors	flag switch "2"-program modeled	flag switch "2"-program modeled	flag switch "2"
stage II start year	1991	1991	1991
phase in period	3 years	3 years	3 years
"system efficiency for light-duty vehicles"	84%	84%	84%
"system efficiency for heavy-duty vehicles"	84%	84%	84%
Local Area Parameter Record	flag switch "1"	flag switch "1"	flag switch "1"
minimum daily temp (°F)	68° F	35° F	68° F
maximum daily temp (°F)	94° F	45° F	94° F
period 1 Reid Vapor Pressure	11.5 psi	13.5 psi	11.5 psi
period 2 Reid Vapor Pressure	9.0 psi	13.5 psi	9.0 psi
period 2 start year	1989	1989	1989
oxygenated fuels flag	flag switch "1"- not modeled	flag switch "1"- not modeled	flag switch "1"- not modeled
diesel sales fraction	flag switch "1"- not modeled	flag switch "1"- not modeled	flag switch "1"- not modeled
reformulated fuel flag	flag switch "2"-modeled	flag switch "2"-modeled	flag switch "2"-modeled
Temperature Values	flag switch "1"- daily average	flag switch "1"- daily average	flag switch "1"- daily average
Composition of Hydrocarbons	flag switch "3" - VOC	flag switch "3" (No hydrocarbons calculated for CO)	flag switch "3" (No hydrocarbons calculated for NOx)
Scenario Section	flag switch "4"- CA LEV Program	flag switch "4"- CA LEV Program	flag switch "4"- CA LEV Program
region	run specific	run specific	run specific
calendar year of evaluation	scenario specific	scenario specific	scenario specific
average speed	85.4°F	40°F	85.4°F
ambient temp (°F)	20.6/27.3/20.6	20.6/27.3/20.6	20.6/27.3/20.6
operating mode fractions	flag switch "7"-July	flag switch "1"-January	flag switch "7"-July
month of evaluation	1994	1994	1994
LEV Program phase-in year	flag switch "1"-standard I/M	flag switch "1"-standard I/M	flag switch "1"-standard I/M
I/M Program for LEV Program			

Table D-1
MOBILE 5 A-H INPUTS (CONT.) – YEARS 2003 THROUGH 2020

	VOCs	Winter CO	NOx
Tampering rates	Mobile 5A-H defaults	Mobile 5A-H defaults	Mobile 5A-H defaults
VMT mix	VMFLAG 1, Mobile5A-H defaults	VMFLAG 1, Mobile5A-H defaults	VMFLAG 1, Mobile5A-H defaults
Annual Mileage Accumulation and/or Registration Distribution by Age	MYMRFG 3 Default accumulation rates/Massachusetts specific registration distribution	MYMRFG 3 Default accumulation rates/Massachusetts specific registration distribution	MYMRFG 3 Default accumulation rates/Massachusetts specific registration distribution
Modified Basic Exhaust Emission Rates (BERs)	Mobile 5A-H defaults	Mobile 5A-H defaults	Mobile 5A-H defaults
Inspection and Maintenance Enhanced Program	IMFLAG 22, (Enhanced I&M and Technician training)	IMFLAG 22, (Enhanced I&M and Technician training)	IMFLAG 22, (Enhanced I&M and Technician training)
program start year	1999	1999	1999
stringency level	20%	20%	20%
first model year subject to program	1984	1984	1984
last model year subject to program	analysis year - 2	analysis year - 2	analysis year - 2
waiver rate pre-1981	0%	0%	0%
waiver rate 1981-present	1%	1%	1%
compliance rate	98%	98%	98%
program type	inspection only	inspection only	inspection only
inspection frequency	biennial	biennial	biennial
vehicles subject to inspection	LDGV,LDGV1,LDGV2,HDGV	LDGV,LDGV1,LDGV2,HDGV	LDGV,LDGV1,LDGV2,HDGV
test type	transient test	transient test	transient test
alternative credits	alternate I/M files specified	alternate I/M files specified	alternate I/M files specified
cutpoint for hydrocarbon	25	25	25
cutpoint for carbon monoxide	50	50	50
cutpoint for nitrogen oxides	2	2	2
Anti-tampering program	ATPFLAG 8 - program modeled	ATPFLAG 8 - program modeled	ATPFLAG 8 - program modeled
program start year	1999	1999	1999
first model year subject to program	1984	1984	1984
last model year subject to program	analysis year - 2	analysis year - 2	analysis year - 2
vehicles subject to program	LDGV,LDGV1,LDGV2,HDGV	LDGV,LDGV1,LDGV2,HDGV	LDGV,LDGV1,LDGV2,HDGV
program type	inspection only	inspection only	inspection only
inspection frequency	biennial	biennial	biennial
compliance rate	98%	98%	98%
inspections performed:			
air system	tested	tested	tested
catalyst	tested	tested	tested
fuel inlet restrictor	not tested	not tested	not tested
tailpipe lead deposit test	not tested	not tested	not tested
EGR system	tested	tested	tested
evaporative system	tested	tested	tested
PCV	not tested	not tested	not tested
gas cap	tested	tested	tested
Pressure data			
program start year	1999	1999	1999
first model year subject to program	1984	1984	1984
last model year subject to program	analysis year - 2	analysis year - 2	analysis year - 2
vehicles subject to inspection	LDGV,LDGV1,LDGV2,HDGV	LDGV,LDGV1,LDGV2,HDGV	LDGV,LDGV1,LDGV2,HDGV
program type	inspection only	inspection only	inspection only
inspection frequency	biennial	biennial	biennial
compliance rate	98%	98%	98%

Table D-1
MOBILE 5 A-H INPUTS (CONT.) – YEARS 2003 THROUGH CONDITIONS

	VOCs	Winter CO	NOx
Purge data			
program start year	1999	1999	1999
first model year subject to program	1984	1984	1984
last model year subject to program	analysis year - 2	analysis year - 2	analysis year - 2
vehicles subject to inspection	LDGV,LDGV1,LDGV2,HDGV	LDGV,LDGV1,LDGV2,HDGV	LDGV,LDGV1,LDGV2,HDGV
program type	inspection only	inspection only	inspection only
inspection frequency	biennial	biennial	biennial
compliance rate	98%	98%	98%
Refueling Emission Factors	flag switch "2"-program modeled	flag switch "2"-program modeled	flag switch "2"
stage II start year	1991	1991	1991
phase in period	3 years	3 years	3 years
"system efficiency for light-duty vehicles"	84%	84%	84%
"system efficiency for heavy-duty vehicles"	84%	84%	84%
Local Area Parameter Record	flag switch "1"	flag switch "1"	flag switch "1"
minimum daily temp (°F)	68° F	35° F	68° F
maximum daily temp (°F)	94° F	45° F	94° F
period 1 Reid Vapor Pressure	11.5 psi	13.5 psi	11.5 psi
period 2 Reid Vapor Pressure	9.0 psi	13.5 psi	9.0 psi
period 2 start year	1989	1989	1989
oxygenated fuels flag	flag switch "1"- not modeled	flag switch "1"- not modeled	flag switch "1"- not modeled
diesel sales fraction	flag switch "1"- not modeled	flag switch "1"- not modeled	flag switch "1"- not modeled
reformulated fuel flag	flag switch "2"-modeled	flag switch "2"-modeled	flag switch "2"-modeled
Temperature Values	flag switch "1"- daily average	flag switch "1"- daily average	flag switch "1"- daily average
Composition of Hydrocarbons	flag switch "3" - VOC	flag switch "3" (No hydrocarbons calculated for CO)	flag switch "3" (No hydrocarbons calculated for NOx)
Scenario Section			
region	flag switch "4"- CA LEV Program	flag switch "4"- CA LEV Program	flag switch "4"- CA LEV Program
calendar year of evaluation	run specific	run specific	run specific
average speed	scenario specific	scenario specific	scenario specific
ambient temp (°F)	85.4°F	40°F	85.4°F
operating mode fractions	20.6/27.3/20.6	20.6/27.3/20.6	20.6/27.3/20.6
month of evaluation	flag switch "7"-July	flag switch "1"-January	flag switch "7"-July
LEV Program phase-in year	1994	1994	1994
I/M Program for LEV Program	flag switch "1"-standard I/M	flag switch "1"-standard I/M	flag switch "1"-standard I/M

Table D-2
VOC EMISSION FACTORS – MOBILE 5A-H
(GRAMS/MILE) 9/4/00

Speed (mph)	1995	1997	2003	2010	2020	2020 used for 2025
idle	19.178	17.06	9.203	7.75	7.47	7.47
2.5	17.015	15.879	6.259	4.901	4.662	4.662
3	13.464	12.517	5.162	4.047	3.856	3.856
4	9.544	8.831	3.901	3.071	2.935	2.935
5	7.461	6.888	3.197	2.53	2.423	2.423
6	6.18	5.701	2.747	2.183	2.095	2.095
7	5.316	4.903	2.432	1.941	1.865	1.865
8	4.818	4.453	2.235	1.784	1.715	1.715
9	4.432	4.104	2.079	1.659	1.596	1.596
10	4.112	3.814	1.949	1.556	1.497	1.497
11	3.841	3.569	1.837	1.468	1.412	1.412
12	3.607	3.357	1.739	1.392	1.339	1.339
13	3.402	3.17	1.652	1.325	1.275	1.275
14	3.22	3.004	1.575	1.265	1.218	1.218
15	3.056	2.855	1.505	1.212	1.167	1.167
16	2.907	2.719	1.44	1.164	1.12	1.12
17	2.77	2.594	1.381	1.12	1.078	1.078
18	2.644	2.478	1.327	1.08	1.04	1.04
19	2.527	2.371	1.276	1.043	1.005	1.005
20	2.426	2.276	1.225	1.004	0.967	0.967
21	2.347	2.199	1.183	0.968	0.931	0.931
22	2.273	2.128	1.143	0.934	0.899	0.899
23	2.206	2.063	1.107	0.903	0.869	0.869
24	2.143	2.002	1.073	0.875	0.841	0.841
25	2.085	1.946	1.042	0.849	0.816	0.816
26	2.03	1.894	1.013	0.824	0.792	0.792
27	1.98	1.845	0.986	0.801	0.77	0.77
28	1.932	1.799	0.961	0.78	0.749	0.749
29	1.887	1.756	0.937	0.76	0.73	0.73
30	1.845	1.716	0.914	0.741	0.711	0.711
31	1.805	1.678	0.893	0.724	0.694	0.694
32	1.768	1.642	0.873	0.707	0.678	0.678
33	1.732	1.607	0.854	0.692	0.663	0.663
34	1.698	1.575	0.836	0.677	0.649	0.649
35	1.666	1.544	0.819	0.663	0.636	0.636
36	1.636	1.515	0.803	0.65	0.623	0.623
37	1.607	1.487	0.787	0.638	0.611	0.611
38	1.58	1.461	0.773	0.626	0.599	0.599
39	1.553	1.435	0.759	0.615	0.589	0.589
40	1.528	1.411	0.745	0.604	0.578	0.578
41	1.504	1.388	0.732	0.594	0.569	0.569
42	1.481	1.366	0.72	0.584	0.559	0.559
43	1.459	1.345	0.708	0.575	0.551	0.551
44	1.438	1.324	0.697	0.566	0.542	0.542
45	1.418	1.305	0.686	0.558	0.534	0.534
46	1.399	1.286	0.676	0.55	0.527	0.527
47	1.38	1.268	0.666	0.542	0.519	0.519
48	1.362	1.25	0.656	0.535	0.512	0.512
49	1.355	1.243	0.654	0.533	0.51	0.51
50	1.349	1.237	0.651	0.531	0.508	0.508
51	1.343	1.231	0.649	0.529	0.506	0.506
52	1.337	1.226	0.647	0.527	0.504	0.504
53	1.332	1.221	0.645	0.525	0.502	0.502
54	1.327	1.216	0.643	0.523	0.501	0.501
55	1.322	1.211	0.642	0.522	0.499	0.499
56	1.349	1.232	0.651	0.529	0.506	0.506
57	1.377	1.253	0.661	0.536	0.513	0.513
58	1.405	1.275	0.671	0.544	0.519	0.519
59	1.434	1.296	0.681	0.551	0.526	0.526
60	1.463	1.318	0.691	0.559	0.533	0.533
61	1.491	1.341	0.702	0.567	0.541	0.541
62	1.521	1.363	0.712	0.575	0.548	0.548
63	1.55	1.386	0.722	0.582	0.555	0.555
64	1.58	1.408	0.733	0.591	0.563	0.563
65	1.61	1.432	0.744	0.599	0.571	0.571

Table D-2
NOx EMISSION FACTORS – MOBILE 5A-H
(GRAMS/MILE) 9/4/00

Speed (mph)	1995	1997	2003	2010	2020	2020 used for 2025
idle	9.73	9.17	6.483	5.77	5.63	5.63
2.5	3.891	3.667	2.593	2.308	2.251	2.251
3	3.72	3.503	2.482	2.209	2.157	2.157
4	3.486	3.279	2.327	2.073	2.025	2.025
5	3.325	3.126	2.221	1.979	1.934	1.934
6	3.203	3.011	2.14	1.906	1.863	1.863
7	3.105	2.919	2.074	1.848	1.806	1.806
8	3.023	2.843	2.018	1.798	1.758	1.758
9	2.953	2.777	1.971	1.755	1.716	1.716
10	2.892	2.72	1.929	1.718	1.679	1.679
11	2.838	2.67	1.892	1.684	1.646	1.646
12	2.79	2.626	1.859	1.654	1.617	1.617
13	2.747	2.586	1.829	1.628	1.59	1.59
14	2.708	2.55	1.803	1.604	1.566	1.566
15	2.673	2.517	1.778	1.582	1.545	1.545
16	2.642	2.488	1.756	1.562	1.525	1.525
17	2.614	2.462	1.737	1.544	1.508	1.508
18	2.588	2.438	1.719	1.528	1.491	1.491
19	2.565	2.416	1.702	1.513	1.477	1.477
20	2.549	2.401	1.69	1.502	1.466	1.466
21	2.545	2.396	1.684	1.496	1.46	1.46
22	2.541	2.391	1.679	1.491	1.454	1.454
23	2.538	2.387	1.675	1.486	1.45	1.45
24	2.535	2.384	1.671	1.482	1.445	1.445
25	2.534	2.381	1.667	1.479	1.442	1.442
26	2.533	2.38	1.665	1.477	1.439	1.439
27	2.532	2.379	1.663	1.475	1.437	1.437
28	2.533	2.378	1.662	1.474	1.436	1.436
29	2.534	2.379	1.661	1.473	1.435	1.435
30	2.536	2.38	1.661	1.473	1.435	1.435
31	2.539	2.382	1.662	1.473	1.435	1.435
32	2.543	2.385	1.663	1.474	1.436	1.436
33	2.548	2.388	1.666	1.476	1.438	1.438
34	2.553	2.393	1.668	1.479	1.44	1.44
35	2.559	2.398	1.672	1.482	1.443	1.443
36	2.566	2.404	1.676	1.485	1.447	1.447
37	2.574	2.411	1.681	1.489	1.451	1.451
38	2.583	2.419	1.686	1.494	1.456	1.456
39	2.593	2.427	1.692	1.5	1.461	1.461
40	2.604	2.437	1.699	1.506	1.468	1.468
41	2.616	2.447	1.707	1.513	1.475	1.475
42	2.629	2.459	1.716	1.521	1.482	1.482
43	2.643	2.472	1.725	1.529	1.491	1.491
44	2.659	2.485	1.735	1.539	1.5	1.5
45	2.676	2.5	1.746	1.549	1.51	1.51
46	2.694	2.516	1.758	1.56	1.521	1.521
47	2.713	2.534	1.771	1.572	1.533	1.533
48	2.734	2.552	1.786	1.585	1.546	1.546
49	2.817	2.627	1.832	1.625	1.584	1.584
50	2.902	2.702	1.879	1.666	1.624	1.624
51	2.988	2.78	1.927	1.708	1.665	1.665
52	3.076	2.859	1.977	1.752	1.708	1.708
53	3.166	2.939	2.029	1.797	1.751	1.751
54	3.259	3.022	2.081	1.843	1.796	1.796
55	3.353	3.107	2.136	1.891	1.842	1.842
56	3.45	3.194	2.192	1.941	1.89	1.89
57	3.55	3.283	2.25	1.992	1.94	1.94
58	3.652	3.375	2.31	2.045	1.991	1.991
59	3.757	3.47	2.372	2.1	2.045	2.045
60	3.866	3.568	2.436	2.157	2.1	2.1
61	3.978	3.668	2.503	2.216	2.158	2.158
62	4.093	3.772	2.572	2.277	2.218	2.218
63	4.213	3.88	2.644	2.342	2.281	2.281
64	4.337	3.992	2.72	2.409	2.347	2.347
65	4.465	4.108	2.798	2.479	2.416	2.416

Table D-2
WINTER CO EMISSION FACTORS – MOBILE 5A-H
(GRAMS/MILE) 9/4/00

Speed (mph)	1995	1997	2003	2010	2020	2020 used for 2025
idle	375.17	320.87	174.89	143.73	136.61	136.61
2.5	150.069	128.346	69.954	57.491	54.642	54.642
3	127.771	109.618	60.189	49.651	47.263	47.263
4	99.346	85.836	47.822	39.698	37.884	37.884
5	81.892	71.29	40.26	33.593	32.12	32.12
6	70.041	61.436	35.126	29.432	28.184	28.184
7	61.452	54.303	31.393	26.398	25.308	25.308
8	54.934	48.892	28.547	24.078	23.103	23.103
9	49.816	44.643	26.299	22.24	21.355	21.355
10	45.689	41.215	24.476	20.745	19.93	19.93
11	42.29	38.391	22.966	19.505	18.745	18.745
12	39.442	36.023	21.693	18.457	17.744	17.744
13	37.021	34.008	20.605	17.559	16.885	16.885
14	34.937	32.273	19.665	16.783	16.141	16.141
15	33.125	30.763	18.844	16.103	15.49	15.49
16	31.533	29.437	18.121	15.505	14.915	14.915
17	30.125	28.263	17.48	14.973	14.404	14.404
18	28.869	27.217	16.907	14.498	13.948	13.948
19	27.743	26.278	16.393	14.071	13.538	13.538
20	26.659	25.263	15.713	13.484	12.971	12.971
21	25.565	24.106	14.874	12.752	12.263	12.263
22	24.568	23.053	14.111	12.086	11.619	11.619
23	23.656	22.091	13.414	11.477	11.03	11.03
24	22.819	21.208	12.775	10.92	10.491	10.491
25	22.048	20.395	12.187	10.407	9.995	9.995
26	21.335	19.645	11.645	9.934	9.538	9.538
27	20.675	18.95	11.144	9.497	9.115	9.115
28	20.061	18.305	10.679	9.092	8.723	8.723
29	19.491	17.706	10.247	8.715	8.359	8.359
30	18.959	17.147	9.845	8.364	8.019	8.019
31	18.463	16.625	9.469	8.036	7.703	7.703
32	17.999	16.137	9.118	7.73	7.407	7.407
33	17.565	15.68	8.789	7.443	7.13	7.13
34	17.159	15.251	8.481	7.174	6.87	6.87
35	16.778	14.849	8.191	6.922	6.627	6.627
36	16.42	14.471	7.918	6.684	6.397	6.397
37	16.085	14.115	7.661	6.461	6.182	6.182
38	15.77	13.78	7.419	6.25	5.978	5.978
39	15.474	13.464	7.19	6.051	5.787	5.787
40	15.197	13.166	6.974	5.863	5.606	5.606
41	14.936	12.886	6.77	5.686	5.435	5.435
42	14.691	12.62	6.576	5.518	5.274	5.274
43	14.461	12.37	6.394	5.359	5.121	5.121
44	14.244	12.134	6.22	5.209	4.977	4.977
45	14.041	11.91	6.056	5.067	4.84	4.84
46	13.849	11.698	5.901	4.933	4.711	4.711
47	13.669	11.498	5.754	4.805	4.589	4.589
48	13.5	11.309	5.614	4.685	4.474	4.474
49	13.507	11.315	5.617	4.688	4.477	4.477
50	13.517	11.322	5.623	4.692	4.481	4.481
51	13.529	11.332	5.629	4.698	4.488	4.488
52	13.545	11.344	5.638	4.706	4.496	4.496
53	13.563	11.359	5.648	4.715	4.505	4.505
54	13.584	11.376	5.66	4.726	4.517	4.517
55	13.608	11.395	5.673	4.739	4.53	4.53
56	15.409	12.708	6.174	5.106	4.87	4.87
57	17.213	14.024	6.677	5.475	5.211	5.211
58	19.02	15.343	7.182	5.847	5.555	5.555
59	20.832	16.666	7.689	6.22	5.901	5.901
60	22.648	17.991	8.199	6.596	6.249	6.249
61	24.468	19.32	8.712	6.975	6.6	6.6
62	26.293	20.653	9.227	7.356	6.954	6.954
63	28.124	21.991	9.746	7.74	7.311	7.311
64	29.96	23.333	10.268	8.127	7.671	7.671
65	31.802	24.68	10.793	8.517	8.034	8.034

Table D-3

STATUS REPORT OF THE 1979, 1982 AND CENTRAL ARTERY STATE IMPLEMENTATION PLAN TCMs

Transportation Control Measures In the 1979 SIP	2000 Transp. Plan	Status in 2000
MBTA Plant Improvements		
•Green Line improvements	X	implemented and ongoing
•Station modernization (Park, State, Washington)		completed - other stations now being modernized (Blue Line)
•Miscellaneous plant improvements		implemented and ongoing
MBTA Vehicle Fleet Improvements	X	implemented and ongoing
Commuter Rail Improvement Program	X	implemented and ongoing
MBTA Park 'n' Ride Program		
•Alewife, Quincy Adams, & Braintree	X	complete - further expansion planned
•Forest Hills	X	complete - further expansion planned
•Mishawam	X	complete - further expansion planned
Reduction and Relocation of bus stops	X	implemented and ongoing
Urban Systems (TOPICS-type) Program	X	implemented and ongoing
Off-Street Parking Freeze - City of Boston		implemented and ongoing
Off-Street Parking Freeze - City of Cambridge		implemented and ongoing
Off-Street Parking Freeze - Logan Airport		implemented and ongoing
Public Information/Promotion		
•Bus stop sign replacement		implemented and ongoing
•Information kiosks		implemented and ongoing
Commuter Boat Service Demonstration (Hingham to Boston)	X	regular contract service ongoing
Red Line Extension from Quincy to Braintree	X	Completed & opened for service in 1980
Red Line Extension from Harvard to Alewife	X	Completed & opened for service in 1985
Orange Line Extension from South Cove to Forest Hills	X	Completed & opened for service in 1987
Downtown Crossing Pedestrian Zone		implemented & ongoing
Boston Resident Parking Sticker Program		implemented & ongoing
Cambridge Resident Parking Sticker Program		implemented and ongoing
MDC On-Street Parking Ban		ongoing
MBTA Pass Program		implemented and ongoing
Masspool, Inc. (CARAVAN)	X	ongoing
Extension of I-93 HOV Lane to Charlestown	X	complete
MBTA Suburban Bus Program	X	ongoing
State/Local Financing Net Cost of T-Service		
• review of fare changes shall involve the public and consider environmental impacts		ongoing
Bicycle Racks at transit stations		ongoing
MDPW (MHD) Bikeway Program		ongoing
Variable Work Hours Program		ongoing
MBTA Idling Reduction Program		implemented and ongoing
Right-Turn on Red		implemented and ongoing
Charlestown Bus Garage		completed 1979
Bus Immersion Heater Program		discontinued, new bus purchases subject to increasingly stringent emission standards
Improved Service Delivery		
• priority signals, automated fare collection, scheduling and routing modifications, & passenger shelters	X	implemented and ongoing
Improved Service Evaluation		ongoing

Table D-3 (cont.)

STATUS REPORT OF THE 1979, 1982 AND CENTRAL ARTERY STATE IMPLEMENTATION PLAN TCMs

Transportation Control Measures in the 1982 SIP	2000 Transp. Plan	Status in 2000
Improved Public Transit		
• Downtown Private Bus Parking		ongoing
• Insurance Discounts for Private Bus Riders		discounts for MBTA pass holders
• Improved Logan Bus Service		ongoing
• Newton Rider Bus Service		discontinued, substituted with MBTA service
Vehicle Replacement & Modernization		completed & ongoing
Area-Wide Ridesharing Programs	X	ongoing
On-Street Parking Controls		
• Resident Parking Sticker Programs		
• Boston Tow and Hold Program		ongoing
• Cambridge Zoning Ordinance Change		
Pedestrian Malls - Auto Restriction Zones		ongoing in Salem, discontinued in other cities; substituted with other program.
Employer-Based Ridesharing Programs		
• Airport Ridesharing Program		ongoing
Road Pricing to Discourage Single-Occupant Vehicles		
• Mass Pike, Callahan/Sumner Carpool Incentive Program		ongoing
Interstate 93 Southbound HOV Lane	X	implemented, ongoing
Traffic Flow Improvements - Urban Systems Projects	X	ongoing
Fringe Parking/Park and Ride Lots	X	ongoing
Long -Range Public Transit Improvements		
• Private Carrier Bus Leasing Program		ongoing
Bicycle Facilities		
• Long distance bike facilities		- implemented
• Bicycle travel on the MBTA		- ongoing
• Bicycle Storage Facilities		- installed at South Acton Commuter Rail Station
Central Artery Mitigation Construction Projects	2000 Transp. Plan	Status in 2000
South Station Bus Terminal	X	Opened for operations on October 28, 1995
South Station Track #12	X	Operating, effective Dec. 20, 1995
Ipswich Commuter Rail extension to Newburyport	X	Revenue service began October 1998
Old Colony Commuter Rail Extension	X	Full weekday service implemented Plymouth and Middleborough Lines in December 1997. Greenbush included in ACO, substitution to be submitted by 11/30/00 for DEP review.
Framingham Commuter Rail Extension to Worcester	X	Interim service started in September, 1995
20,000 new park and ride and commuter rail station parking spaces	X	Ongoing, 16,333 spaces completed, notification of extension to DEP. Petition for delay until 12/31/01 accepted by DEP.
Blue Line Platform lengthening and modernization	X	Six stations have been modified for 6 car trains. Work continues on downtown stations. Petition for delay until 12/31/01 accepted by DEP.
Green Line Arborway Restoration	X	EOTC must revise its existing feasibility study on Arborway and submit to DEP by 2/28/01.
South Boston Piers Electric Bus Service	X	Petition for delay until 12/31/03 accepted by DEP.
Green Line Extension to Medford Hillside (Tufts)	X	Scheduled completion 2011
Blue Line Connection from Bowdoin Station to Red Line at Charles Station	X	Scheduled completion 2011

Table D-3 (cont.)

STATUS REPORT OF THE 1979, 1982 AND CENTRAL ARTERY STATE IMPLEMENTATION PLAN TCMs

Central Artery Mitigation Study Projects	2000 Transp. Plan	Status in 2000
I-93 Southbound HOV Lane to Mystic Avenue	X	Completed
I-93 HOV Lane from Mystic Avenue to Route 128		Further study required
I-93 (SE Expressway) HOV Lane from I-90 to Route 3	X	Opened November, 1995
Development of issues to be addressed in the Program for Mass Transportation	X	PMT adopted 1994
Toll Pricing feasibility to Logan Airport		in progress
Feasibility of toll booth on Route 1A		completed June, 1994
Feasibility of water shuttle between Boston and North Shore	X	completed 1991
Transit improvements study - PMT	X	PMT adopted 1994
Feasibility of rail connection between South Station and Logan Airport		final report issued July, 1994
Expansion of size and number of Logan Express service parking and transit facilities	X	completed June, 1994
Expanding high occupancy vehicle lanes and services within Logan Airport	X	completed June, 1994
Connecting circumferential transit facilities and radial transit services	X	interim cross-town service started September, 1994; Urban Ring Study underway
Upgrade rail service to NY; Worcester & Springfield, MA.; Hartford, CT.; and Portland, ME.	X	in progress
Examine indexing of transit fares	X	ongoing, indexing issue discussed as part of annual fare review.
Feasibility of HOV Lanes on I-90 between I-93 and I-95	X	completed 1994

An Administrative Consent Order (ACO) was signed by EOTC and the Executive Office of Environmental Affairs (EOEA) on September 1, 2000. The ACO reconciles and adjusts dates of completion for all projects required as mitigation for the Central Artery that have not been completed to date. This conformity determination includes all projects that are part of the ACO.

Table D-4

CATEGORICALLY EXEMPT PROJECTS

Certain transportation projects eligible for federal funding have no impact on regional emissions. These are 'neutral' projects that, because of their nature, will not affect the outcome of regional emissions analyses and add no substance to those analyses. As a result, DOT and EPA have agreed that such projects may be excluded from the regional emissions analyses required in order to determine conformity of TIPs and Plans. Projects eligible for this treatment are as follows:

Safety

Railroad/highway crossing
Pavement marking demonstration
Hazard elimination program
Safer off-system roads (non-federal-aid system)
Emergency relief (23 U.S.C. 125)

Also specific projects for:

- intersection channelization projects
- shoulder improvements
- truck size and weight inspection stations
- safety improvement program
- intersection signalization projects
- railroad/highway crossing warning devices
- changes in vertical and horizontal alignment
- increasing sight distance
- guardrails, median barriers, crash cushions
- pavement resurfacing and/or rehabilitation
- widening narrow pavements or reconstructing bridges (less than one travel lane)
- noise attenuation
- fencing
- skid treatments
- safety roadside rest areas
- other traffic control devices
- truck climbing lanes
- lighting improvements
- adding medians

Mass Transit

- Purchase of office, shop, and operating equipment for existing facilities
- Purchase of operating equipment for vehicles (e.g. radios, fareboxes, lifts, etc.)
- Construction or renovation of power, signal, and communications systems
- Operating assistance
- Rehabilitation of transit vehicles
- Reconstruction or renovation of transit buildings and structures (e.g. rail or bus buildings, storage and maintenance facilities, stations, terminals, and ancillary structures)
- Construction of small passenger shelters and information kiosks
- Rehabilitation or reconstruction of track structures, track, and trackbed in existing rights-of-way
- Noise attenuation
- Purchase of support vehicles (e.g. autos, vans)
- Purchase of new buses and rail cars to replace existing vehicles or for minor expansion of the fleet to provide new service
- Construction of new bus and rail storage and maintenance facilities which meet the conditions for categorical exclusion specified in 23 CFR 771

Table D-4 (cont.)
CATEGORICALLY EXEMPT PROJECTS

Air Quality

- Continuation of ride-sharing and van-pooling promotion activities at current levels
- Bicycle projects
- Pedestrian facilities

Other

- Engineering to define elements of proposed action or alternatives to assess social, economic, and environmental effects
- Advance land acquisitions as prescribed in 23 CFR 771
- Acquisition of scenic easements
- Plantings, landscaping, etc.
- Sign Removal

Table D-5
SUMMARY OF OFF-MODEL EMISSIONS
FOR MBTA BUSES, COMMUTER RAIL, COMMUTER BOAT WITHIN AND
SURROUNDING THE BOSTON MPO AREA
(ALL EMISSIONS IN TONS/SUMMER DAY)

	2003 Action	2010 Action	2020 Action	2025 Action
VOC				
MBTA Bus	0.196	0.194	0.194	0.194
Comm Rail	0.330	0.281	0.244	0.228
Comm Boat	0.431	0.431	0.431	0.431
Total VOC	0.957	0.906	0.869	0.853
NOx				
MBTA Bus	1.043	0.783	0.783	0.783
Comm Rail	7.195	5.027	4.327	4.031
Comm Boat	0.815	0.815	0.815	0.815
Total NOx	9.053	6.625	5.925	5.629

Table D-5 provides supplemental emissions information on activities that occur across MPO boundaries in Eastern Massachusetts. CTPS has the capability of calculating these emissions and has provided this information for the Boston MPO Region. These emissions have not been included in the Plan analyses for any other MPOs in Eastern Massachusetts. Emissions have been provided for the commuter rail, commuter boat and the MBTA bus activities. The emissions from Table D-5 were combined with the emissions from the ten MPOs in Eastern Massachusetts.





